Pandromeda

Presents the

MojoWorld Generator Quick Start Tutorial

This tutorial is designed to be used with MojoWorld Generator Version 3.0. If you start with another version of MojoWorld Generator, some of it may not make sense.

Cross-platform note: The notation <C-X> indicates the combination of the **Control** and **x** keys on Windows, and the combination of the **Command** and **x** keys on a Macintosh.

If you haven't already done so, you should first go into Viewer UI (by hitting <C-T>) and review the MojoWorld Viewer Quick Start Tutorial. In this tutorial we'll assume that you already know the basics covered in that tutorial.

The term "drag" below means to move your mouse with the (left) mouse button pressed.

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Creating a New Planet

First, make sure you're in the Generator Interface by hitting <C-G>. You're now viewing the simple but incredibly powerful MojoWorld Generator UI.

We're going to build a new planet entirely from scratch. It will take a while, but after you're done you'll have a grasp of most of the fundamentals of the Generator and planet building. In the interest of brevity, we'll only cover the basics. The MojoWorld Generator v3 manual covers the details of the Generator UI. Our goal here is to get you going as quickly as possible.

Okay, let's go!

First, make sure that the **RTR** (Real Time Renderer) isn't paused. If you see the **Pause** warning

click the **Jump** icon on the top bar to start it up again.

Now create a new planet by hitting <C-N>. (There is another way to create a new planet with MojoWorld 3's improved **Planet Wizard** interface, but this tutorial is about the Generator UI. The Planet Wizard can make new planets very quicky by allowing you to select from a variety of different preset options. It's fairly self-explanatory and fun—though what we're about to get into here will give you far more control over your planet.)

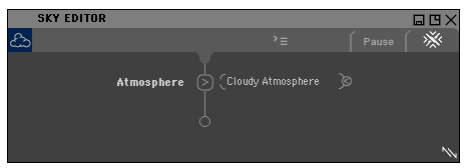
When you create a brand new file, your view is 200 meters above the surface of a featureless planet looking out at the horizon. We're going to build it up into a simple world by modifying the sky, creating and coloring the terrain, and by adding and texturing an ocean.

You might want to click the **Camera** icon at this point to see just how fast MojoWorld can render an empty planet. You'll see that the rendering time slows down as we add more features to our new world which gives MojoWorld more work to do as it renders an image.

Creating a Sky

To the left of the **RTR Window** you'll see the **Global Parameters Hot Buttons**. They're divided into two sections, "things above the planet's surface" and "things on the planet's surface." The lower section which corresponds to surface features is further divided into the elements of water and land. If a different set of hot buttons is being displayed (such as those for a primitive), the **Global Parameters Hot Buttons** can be brought back by clicking on the **Global Parameters** icon.

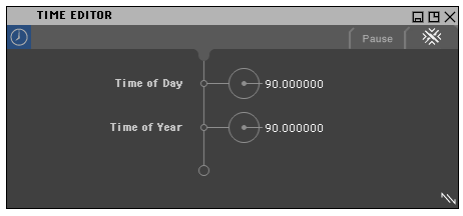
The **Sky Hot Buttons** consist of the **Stars Editor**, the **Sun Editor**, the **Moons Editor** and the **Sky Editor**. We'll only be looking at the **Sky Editor** and **Stars Editor** in this tutorial. Click the cloud icon to open the Sky Editor.



First let's simplify things further. Click on the **DDLB** (drop-down list box) icon to the right of **Cloudy Atmosphere** and select **None**.

Time of Day and Time of Year

Now we have a black sky. The red line up the middle indicates the path of the **Sun** across the sky. Click the **Time** icon near the upper left corner of the **RTR Window**. This opens the **Time Editor**.



Drag the horizontal bar in the **Time of Day** circle

until it's somewhere around 170 to 175 degrees. You'll see a little white circle moving along the red line in the **RTR Window**. That's the sun! This is how you change the time of day in MojoWorld.

Next rotate the **Time of Year** control

and see how the red line indicating the sun's path swings back and forth across the screen. This corresponds to the seasonal change in the angle of the ecliptic. This will become more relevant in future versions of MojoWorld, when planets reside in solar systems.

Move the **Time of Year** control back to near 90, the **Time of Day** control to somewhere near 45 and then stow the **Time Editor** by clicking the **Minimize** icon at the upper right. The **Time Editor** moves into the **Editor Stow** area

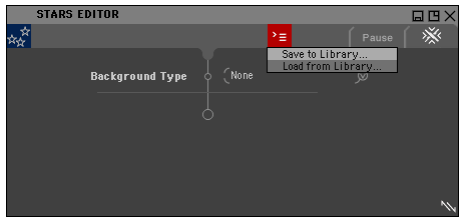
to the lower left of the **RTR Window**. This handy feature lets you have lots of editors open in MojoWorld without cluttering your screen.

Texturing the Celestial Sphere

One of the cool things about MojoWorld is that you can "paint" anything onto the sky dome, or celestial sphere representing outer space. (Don't get too attached to this feature—in the future outer space in MojoWorld will become a three dimensional volumetric texture!)

Let's put some stars in the sky. We're not going to get very involved yet, we'll just be loading a starry backdrop from the library. We're starting with baby steps.

Click the **Stars Editor** icon in the **Global Parameters Hot Buttons** to open the Stars Editor. Use the menu icon in the Stars Editor to select **Load from Library**.



Find and select the preset **SimpleStarfield.mjl**. Dismiss the **Stars Editor** by clicking the **Close** icon in the upper right hand corner of the **Stars Editor** window.

Let's have a look at our handiwork now. Click the **Crop Window** icon above the RTR Window to open a **Crop Window**. Drag on the **Crop** label

to move the Crop Window up into the sky. Also note that you can resize the **Crop Window** by dragging on the upper left or lower right corners.

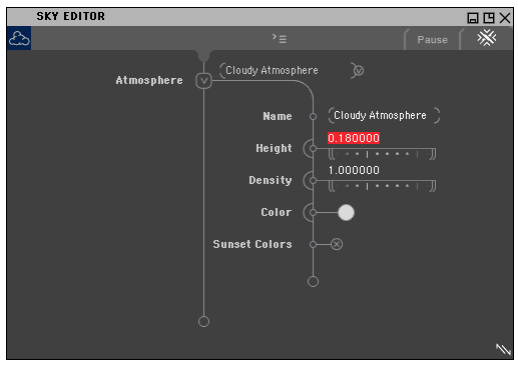
Select Normal from the Render Quality menu.

Click the **Camera** icon and you'll see that the sky is no longer black, but has lots of stars of varying sizes. Click the **Crop Window** icon again if you'd like to dismiss the **Crop Window**. (You may want to leave it open for the work we're about to do.)

Creating an Atmosphere

Now let's create a planetary atmosphere for blue skies. In the **Sky Editor** select **Cloudy Atmosphere** from the **Atmosphere** DDLB.

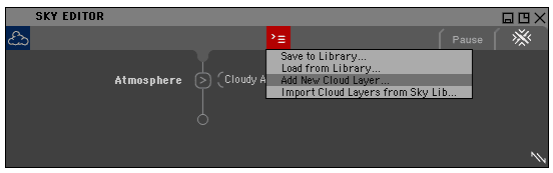
Presto! You now have blue skies. If you open the **Control Stack** for the **Atmosphere** by clicking on the **Control Stack** icon, you'll find all kinds of controls. You'll also want to resize the Sky Editor window by dragging on the resize icon in the lower right.



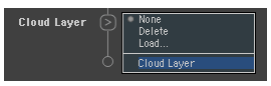
You can read about all those controls in the MojoWorld manuals. For now, just change **Height** to 0.18 and we'll move on. Collapse the **Control Stack** for **Atmosphere** by clicking the **Close Control Stack** icon.

Creating a Cloud Layer

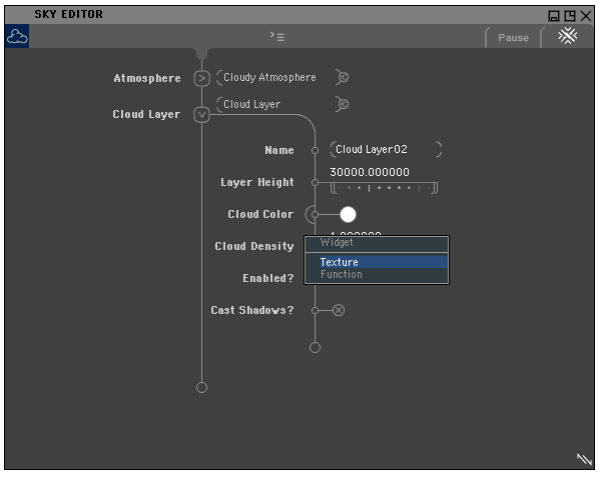
Let's add some clouds. Select **Add New Cloud Layer** from the menu in the **Sky Editor**.



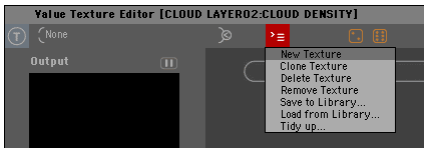
Select **Cloud Layer** from the **Cloud Layer DDLB**.



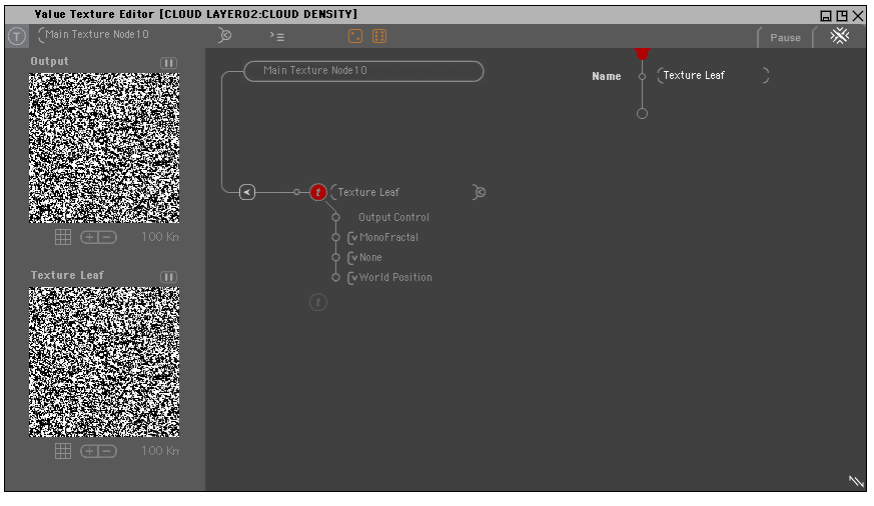
Open the **Cloud Layer Control Stack**. Click the semicircle icon next to **Cloud Density** and choose **Texture** from the menu.

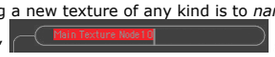


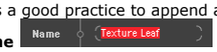
This opens MojoWorld's ultra-powerful **Texture Editor**. From the menu icon at the top, select **New Texture**.



Click on the ghosted **Circle-T** icon once to enable the first texture leaf. Click it a second time to expand the new texture leaf's **Kickstand**.

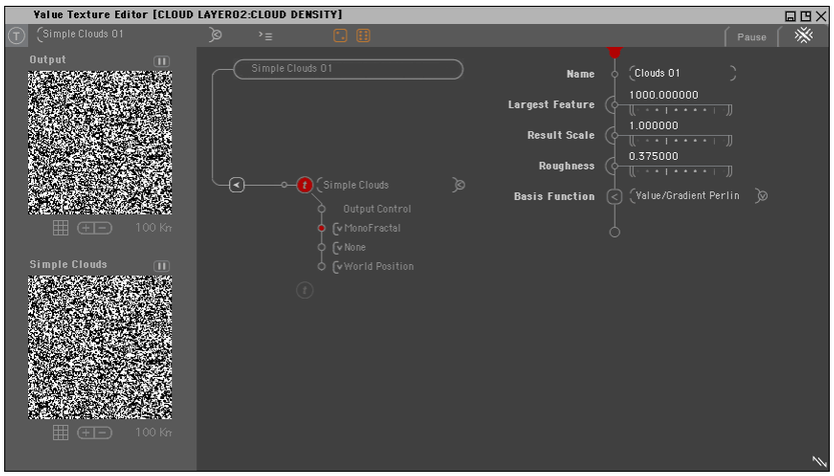


The first thing you always want to do when creating a new texture of any kind is to *name* it. If you don't, after you've been working for a while you'll accumulate lots of textures and texture nodes with similar names which you can't tell apart. So highlight "**Main Texture Node**" 

and change it to "**Simple Clouds 01**." (It's a good practice to append a number to your names in case you want to use the same name again for a different item, so we'll append "01" to a lot of our names throughout this tutorial.) Similarly, change the **Texture Leaf Name** 

from "**Texture Leaf**" to "**Simple Clouds**."

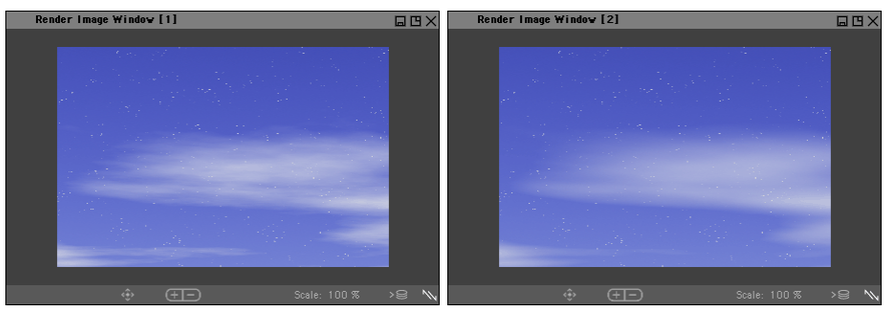
Now click **Monofractal** to open its **Control Stack** and rename "**MonoFractal**" to "**Clouds 01**."



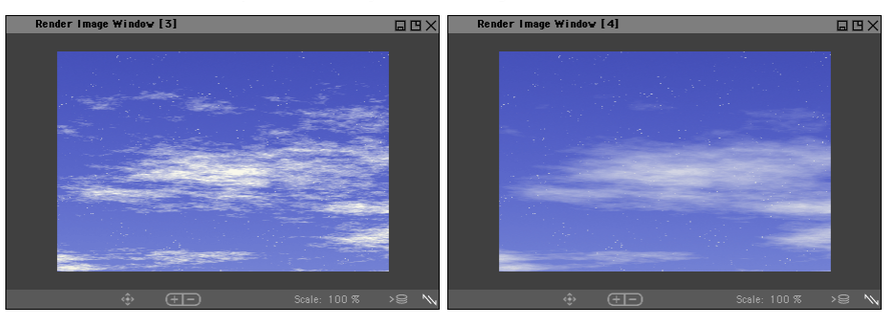
Now for one of the ways you have to train yourself to think when using MojoWorld: By default planets in MojoWorld have a radius of 6,000,000 (six million) meters, or 6,000 kilometers (a kilometer being 1,000 meters by definition). That's approximately the same radius as planet Earth. It's really *big*. So one of the first things you have to do when working in MojoWorld—unlike any other 3D graphics software—is to *think big*. Think *really big*. Since MojoWorld can't know what purpose you're using anything for when you create it, its default values are usually *way* off. You need to adjust them immediately to the size you have in mind.

To make your clouds realistically big for a planet, change the **Largest Feature** to 100,000. This changes the largest cloud "blob" from one kilometer (1,000 meters) in size to 100 kilometers, or the size of a weather system on Earth.

Then there's the very powerful **Roughness** control. You should take a little time to familiarize yourself with its effects. Let's do a few experiments right now. Set your **Render Quality** to **Low** and make a test rendering with **Roughness** set at the default value of 0.375. Now change **Roughness** to 0.25 to make the clouds very soft; try a test rendering of that. Next try 0.75—very tattered clouds! Finally, set **Roughness** to 0.5 and leave it there. **Roughness** is one of the most potent controls in MojoWorld. Think of it as controlling the visual complexity or "busy-ness" of your textures and terrains. Be sure to experiment with it every time you create something in the **Texture Editor**.

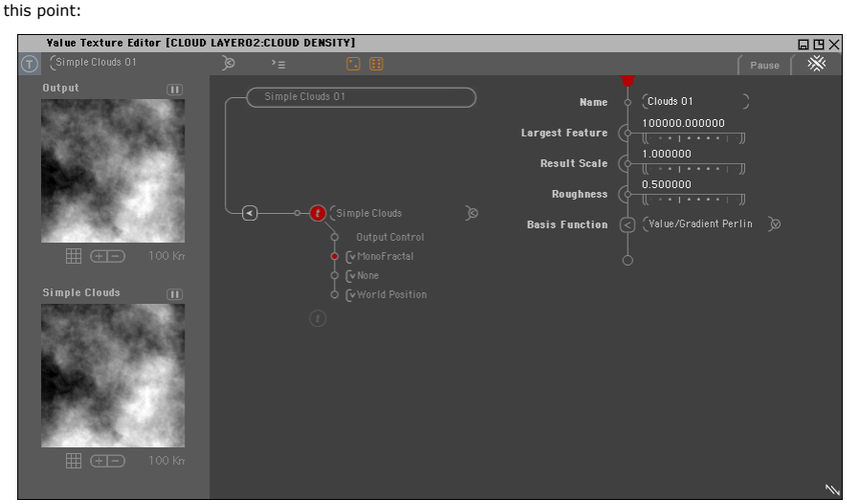


Crop Window rendering of clouds with **Roughness** of 0.375 and 0.25.

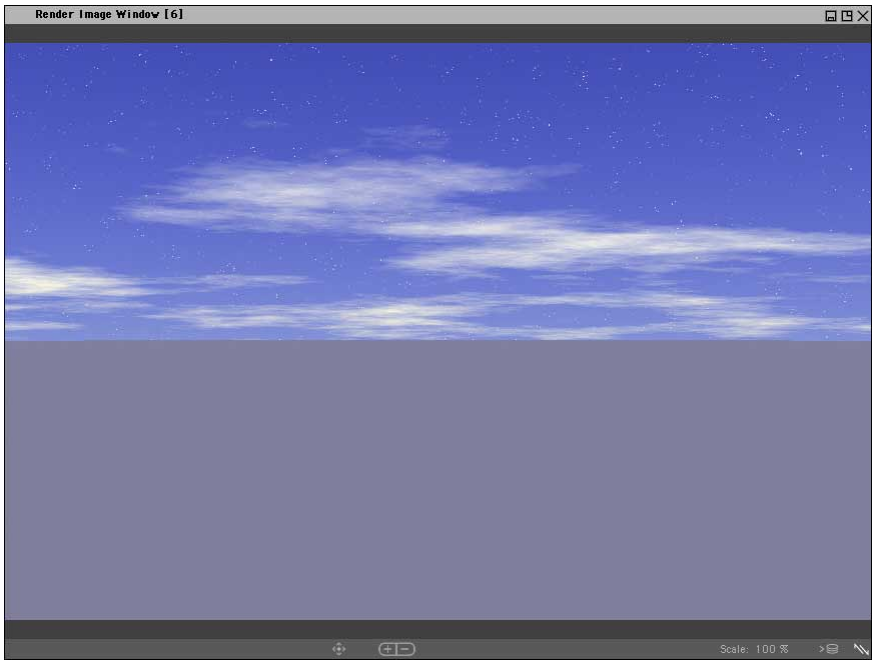


Crop Window rendering of clouds with **Roughness** of 0.7 and 0.5.

This is what your Texture Editor window should look like at this point:



A rendering at **Normal** quality should now look like this:



Okay, now we have a nice simple sky and atmosphere. Let's make some mountains!

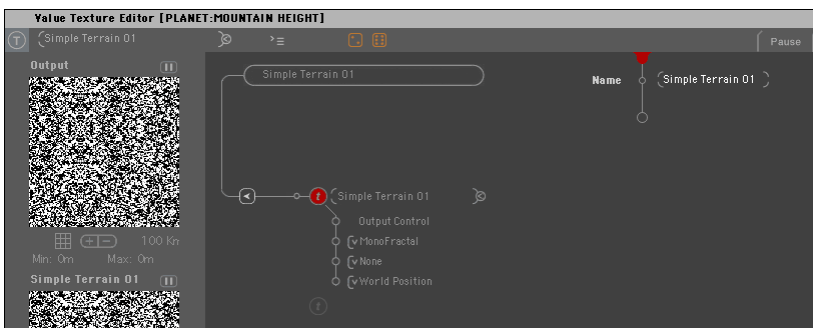
Creating the Land

MojoWorld terrains are simply grayscale textures, so we create them in the **Texture Editor**, too. The grayscale texture serves as a displacement to the spherical planetary surface. (Displacements are what MojoWorld is all about. You can even displace your displacements in MojoWorld, yielding terrains with overhangs, but that's an advanced topic.) Generally the idea is to have this displacement texture look like natural terrain—mountains. Sometimes we'll do fantastical displacements, though, "just because we can." MojoWorld users do some really wild stuff that makes for some mighty interesting "planets." :-)

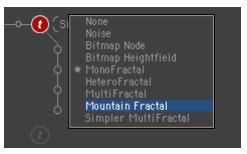
Creating the Terrain Shape

Go back to the lower group of **Global Parameters Hot Buttons**. Under the **Mountain** icon click the **Circle-T** icon. This opens the **Texture Editor** again. Select **New Texture** from the menu.

Click twice on the **Circle-T** in the **Texture Editor** to open the **Kickstand** for our new texture. Rename "**Main Texture Node**" and "**Texture Leaf**" to "**Simple Terrain 01**."



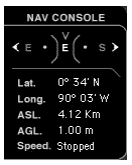
Now we want to change the type of fractal we're using. Click the **DDLB** icon next to **MonoFractal** and select **Mountain Fractal**.



HOT TIP: The reason you don't see anything happen to the surface of the planet immediately is that the texture's result scale is 1 meter, by default, while the **RTR** samples the planet surface at 2 meter intervals. Therefore the default texture results in a planet that is essentially flat. The details that are present are too small to be resolved in the **RTR**!

We'll fix that by scaling our texture up to where it's mountain-sized. Make the biggest mountains about 100 km (~60 miles) across by changing **Largest Feature** to 100,000. Make them about 10 km (~30,000 feet) high by changing **Result Scale** to 10,000. Now you'll see some terrain pop up in the **RTR Window**.

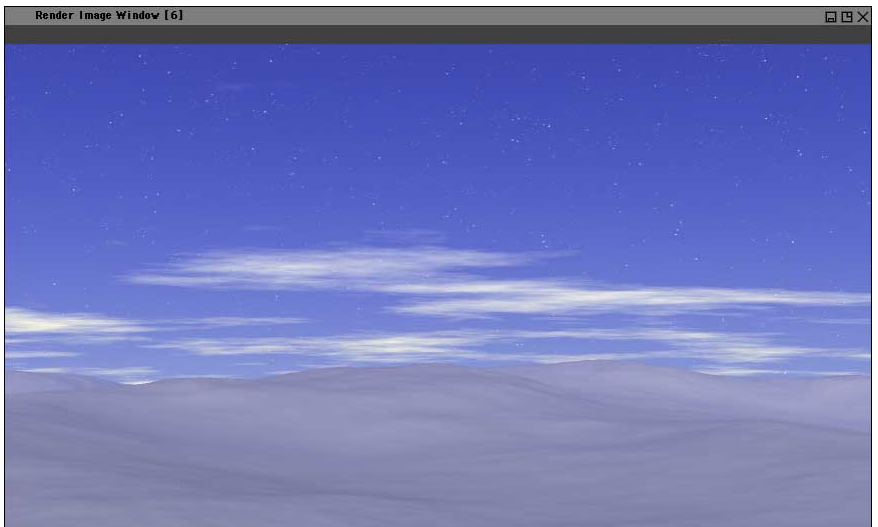
Something just happened in your **RTR Window**—the mountains just grew up right under the camera, and now we're right down on the surface. How can we tell? Look at the **Nav Console** to the lower left of the **RTR Window**:

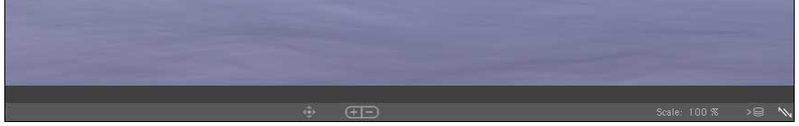


The **AGL** field indicates how high we are above ground level. (**ASL** tells us how high we are above sea level, but since we don't have an ocean yet so it doesn't mean much—but it does tell us that the mountains pushed the camera up over four kilometers!)

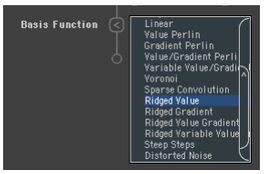
Click in the **RTR Window** to move MojoWorld's input focus there, then hit the "**b**" key on your keyboard. This automatically pops us up to 10 km **AGL** with the camera level—a very handy keystroke to remember!

A rendering at Normal quality should look like this:

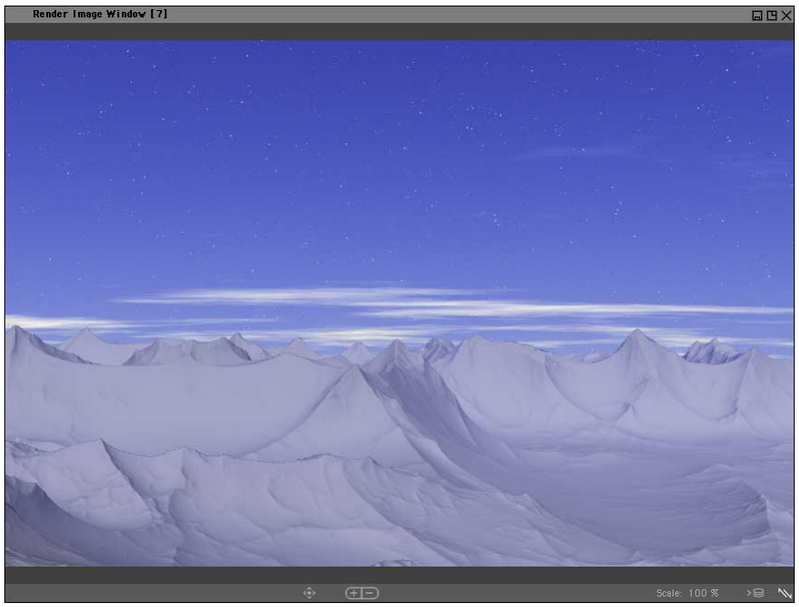




Next we'll make the terrain more interesting by building it out of a different **Basis Function**. Click on the **Basis Function DDLB** icon to the right of **Value/Gradient Perlin** and select **Ridged Value**.



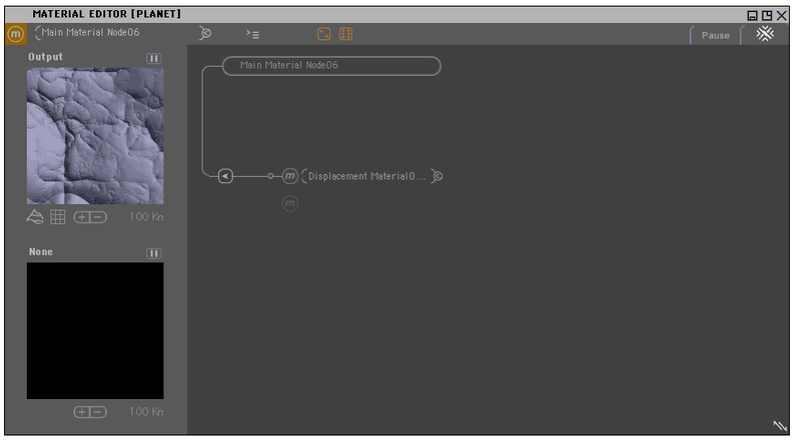
Once again, the mountains pushed the camera up. Click in the **RTR Window** again and hit the "**b**" key to move the camera up to a decent altitude for viewing the terrain. A rendering at **Normal** quality should now look like this:



Okay, now we have some simple terrain. Let's add some color to it.

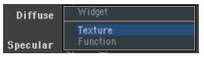
Adding a New Material

Click the red **Circle-M** icon beneath the **Mountain** icon in the **Global Parameter Hot Buttons** to the left of the **RTR Window**. This opens MojoWorld's **Material Editor** for the material applied to the planet.



Click on the **Circle-M** icon to the left of **Displacement Material** to open the material's **Control Stack**. Rename "**Main Material Node**" to "**Simple Material Node 01**" and rename "**Displacement Material**" to "**Simple Material 01**."

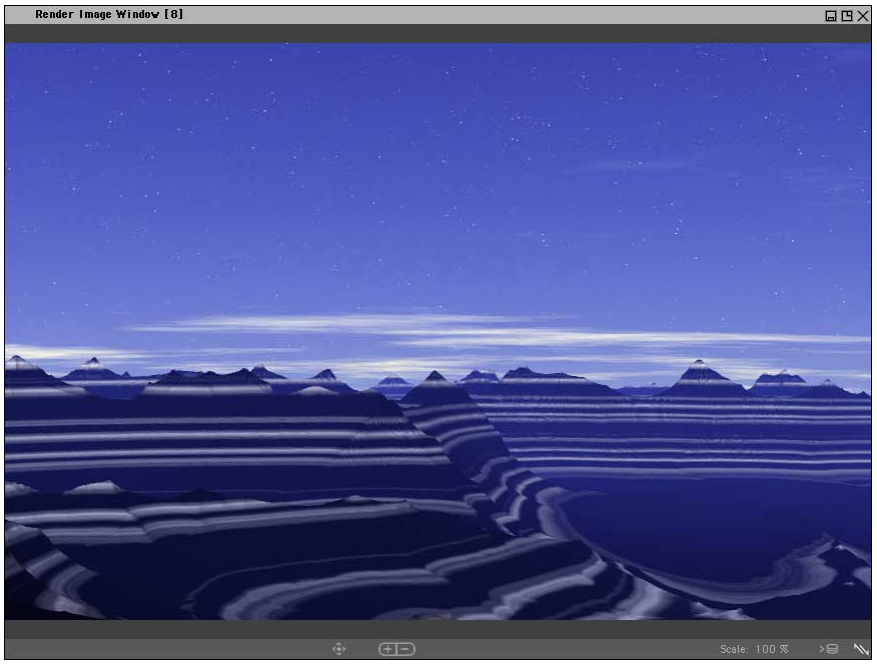
Now we'll drive the **Diffuse** color channel with a texture. Click on the **Semicircle** icon next to **Diffuse** and select **Texture** from the menu.



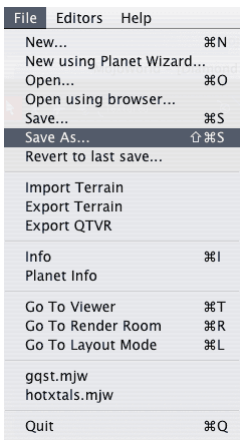
Once again, this opens the **Texture Editor**. Select **New Texture** and click twice on the **Circle-T** icon to open the **Kickstand**. We're going to build a simple color-by-altitude texture for our terrain. Start by renaming "**Main Texture Node**" to "**Color by Altitude Node 01**" and renaming "**Texture Leaf**" to "**Color by Altitude 01**."

Next click the **DDLB** icon next to **World Position** and select **Altitude**.

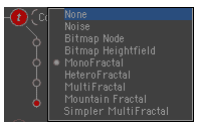
If you do a rendering at **Normal** quality now you'll see that we have a grayscale texture consisting of a fractal distribution of horizontal bands which resemble bedrock.



You might want to save this for later use. You can do that by selecting **Save As** from the **File** menu at the upper left of the main MojoWorld window (PC) or on the top menu bar (Mac).



Let's add some color. First turn off the fractal driving the color by selecting **None** from the **DDLB** for **Monofractal**.

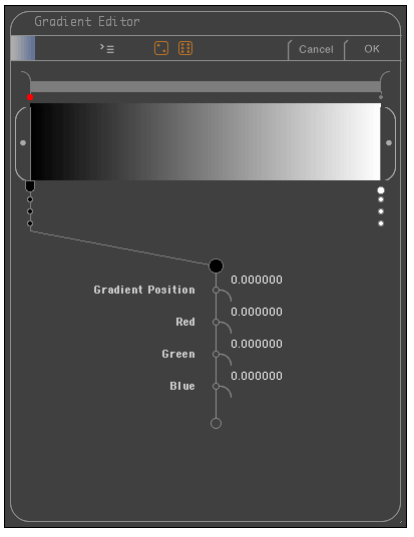


We want this texture to be relative to **Sea Level**, so that when we move sea level up and down, the color at the coast remains constant. We accomplish this by clicking the circle next to **Use Sea Level** in the **Control Stack**.

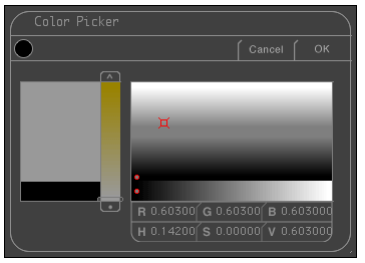
We get at the color **Gradient** by clicking **Output Control** on the **Kickstand**. Rename "**Texture Color Control**" to " **Color by Altitude Gradient 01**" in the **Name** field of the **Control Stack**.

Open the **Gradient Editor** by clicking the **Gradient** icon

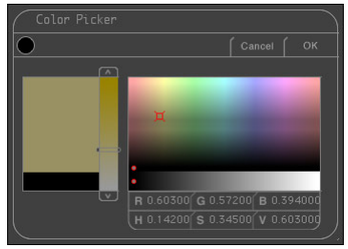
in the **Control Stack**. Click the small black circle directly beneath the left end of the **Gradient** to modify the color there.



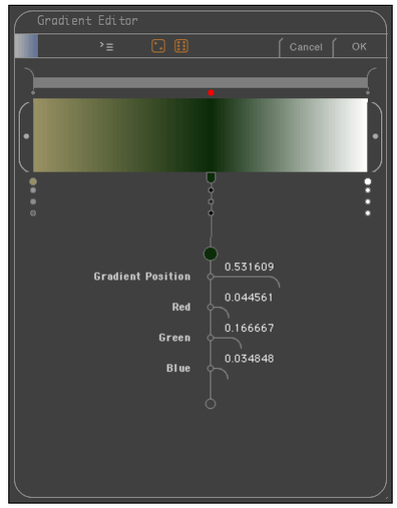
Click the **Color Dot** in the middle of the **Gradient Editor** to open the **Color Picker**. Drag the **Color Location** icon up and to the left to where we see a shade of ocher in the **Color Picker**.



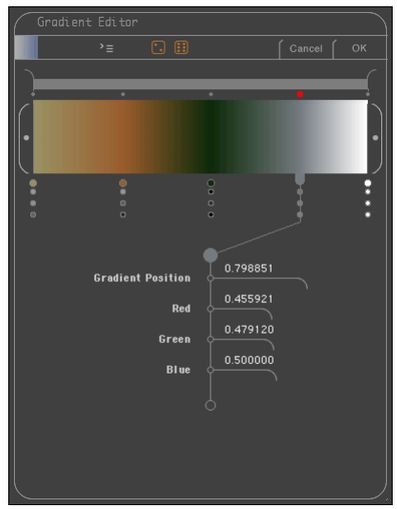
Slide the **Saturation Bar** up to where you get a nice sand color and click **OK**.



Click the bottom edge of the **Gradient** near the middle to add another color node to the **Gradient**. Make this a dark green to represent vegetation.



Add a blue-grey node toward the top of the Gradient to represent stone, and a reddish one towards the bottom to represent scrub.

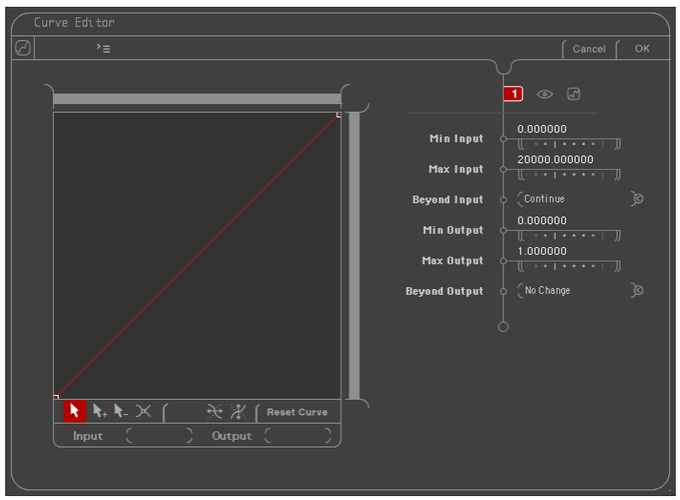


Click **OK** to exit the **Gradient Editor**.

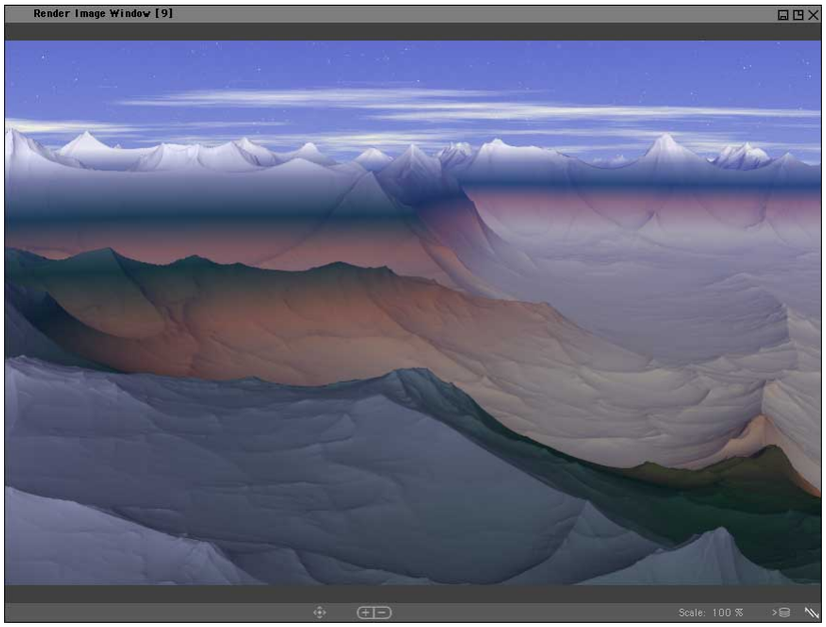
Now we need once again to adjust things to the huge planetary scale of MojoWorld. Click on the **Curve** icon to the right of **Input Curve**.

This opens the powerful **Curve Editor**. You can evoke any number of effects using the **Curve Editor**, but for now we'll just use it to adjust the scale of our coloring by altitude.

Here's what we need to do: As MojoWorld has no way of knowing the scale at which you're going to use an effect, it just defaults to reasonable values such as 0.0 or 1.0. We want to color our terrain with our color **Gradient** from **Sea Level** to the mountain tops. By default the gradient goes from 0.0 to 1.0, or from **Sea Level** to one meter in altitude—not what we have in mind at all. We want to apply from **Sea Level** to the mountain tops. **Sea Level** is at zero altitude, so that's okay. The mountain tops are around 20,000 meters high (the **Mountain Fractal** and **Ridged Value Basis Function** we used to create them makes them larger than the 10,000 meters we specified). We therefore want to change the input range from 0.0 to 1.0, to 0.0 to 20,000. We do this by changing **Max Input** value in the **Curve Editor** from 1.0 to 20,000.



Now you'll see color on your terrain in the **RTR Window**. Drag up in the **RTR Window** to point the camera down and rendering at Normal quality will yield a picture like this:

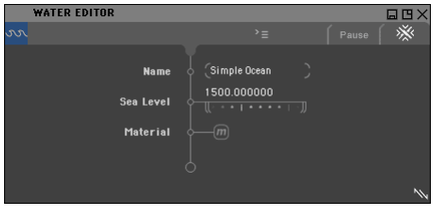


Things look pretty dry down there, though, so we'll fix that by adding an **Ocean** to our planet.

Adding an Ocean

Adding an ocean to a planet is easy. Clicking on the **Water** icon in the **Global Parameters Hot Buttons** opens the **Water Editor**. Select **Create Ocean** from the menu there.

Change the **Name** from "**Ocean**" to "**Simple Ocean**" and **Sea Level** to 1500.0. Then click on the **Circle-M** icon to open the **Material Editor**.

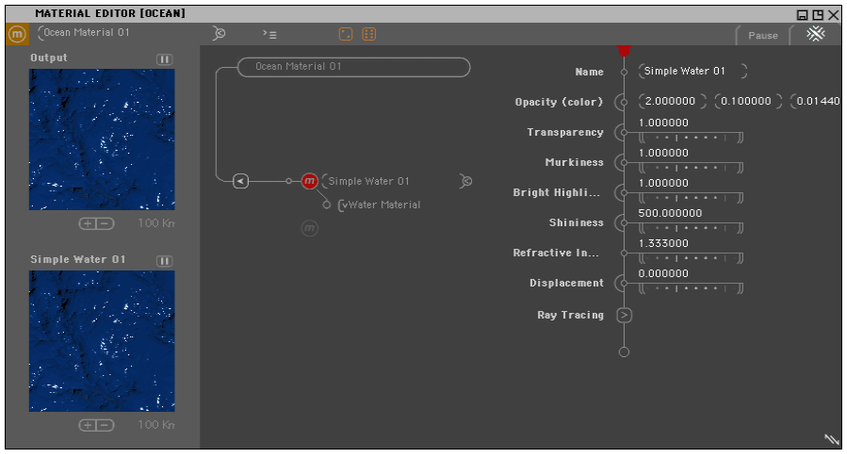


Select **New Material** from the menu in the **Material Editor**.

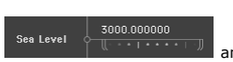
First thing, change the **Material Name** to "**Ocean Material 01**."

Click the **Circle-M** icon to the left of **Displacement Material** to open the material's **Kickstand**. Click the **DDLB** icon to the left of **Displacement Material** in the **Kickstand** and select **Water Material**.

This opens the **Control Stack** for the **Water Material**. Change the **Name** from "**Water Material**" to "**Simple Water 01**."



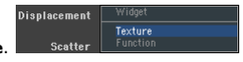
You can see that there are a lot of controls available for water materials. The one that's most fun to play with is the **Murkiness** value. Change it to 0.0 for extremely clear water. Try values of 10, 100 and 1,000 and see how the water gets murkier to the point where it's downright muddy. MojoWorld uses an accurate simulation of light propagation through water to get these effects. Let's leave **Murkiness** at the super-clear water value of 0.0 and move on.

To see what our water looks like, click the **Water** icon in the **Global Parameter Hot Buttons** area again to open the **Water Editor**. Set **Sea Level** to 3,000 

and the water will rise up in the **RTR Window**. A rendering at **Normal** quality will look like this:

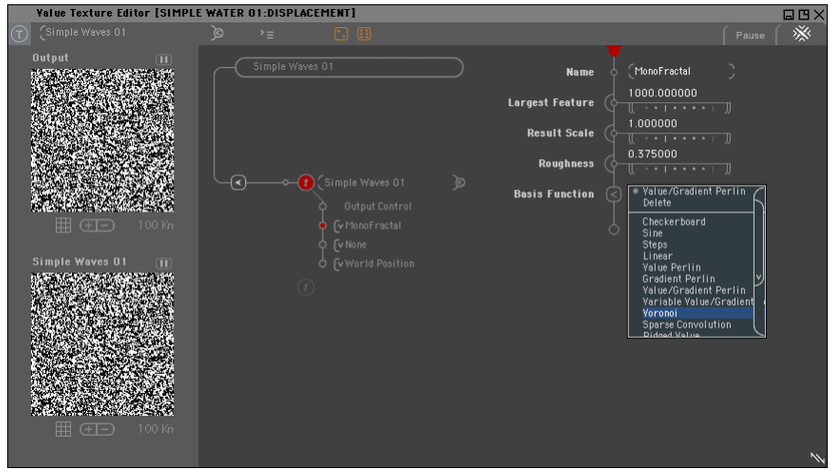
To finish this tutorial, let's add some waves to the **Water** material.

In the **Material Editor** for the **Ocean**, click the **Semicircle** icon for **Displacement**

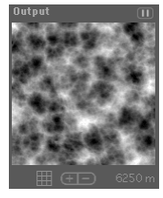
and select **Texture**. 

This opens the **Texture Editor** once again.

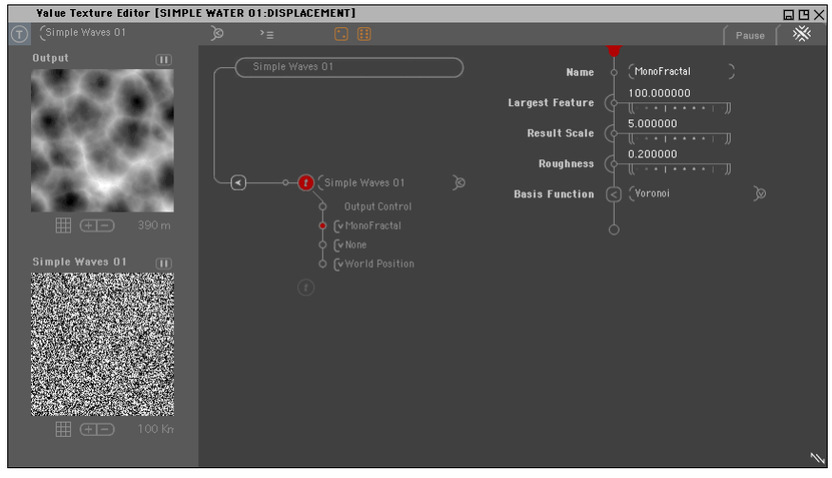
Select **New Texture** from the menu. Click twice on the **Circle-T** to open the **Kickstand** for our new texture. Rename "**Main Texture Node**" and "**Texture Leaf**." Click on **MonoFractal** to open its **Control Stack**. From the **Basis Function DDLB** select **Voronoi** to give us waves with sharp crests and rounded troughs.



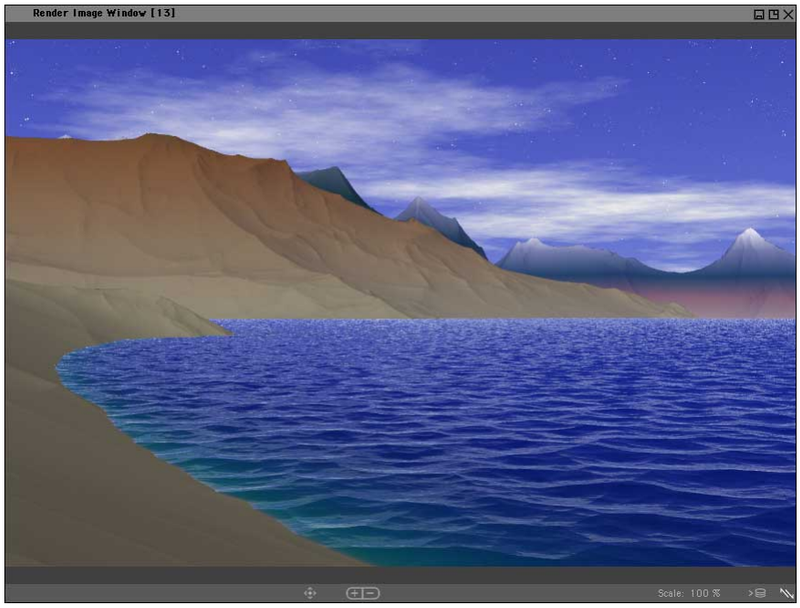
Click on the Zoom In icon beneath the top Texture Preview Window to get a closer look at the texture.



We don't want our water to be too rough, so reduce **Roughness** to 0.2. Next we want to scale the waves to be realistic in size and character. Let's make our largest waves 100 meters (~300 feet) in horizontal size by changing **Largest Feature** to 100. You may need to zoom in some more to see the texture well. We want to make our waves about 15 feet high, so set **Result Scale** to 5.0 meters.



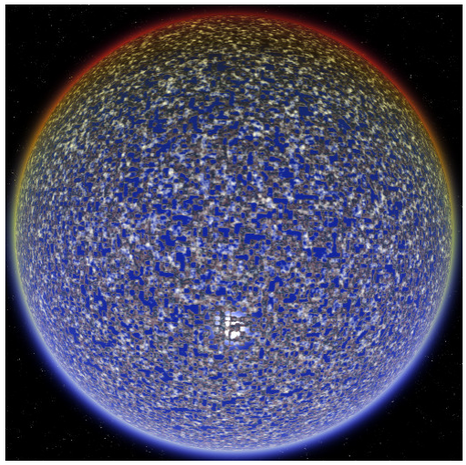
Walking the camera down to within 30 meters of the ground next to the shoreline and taking another render at Normal quality looks like this:



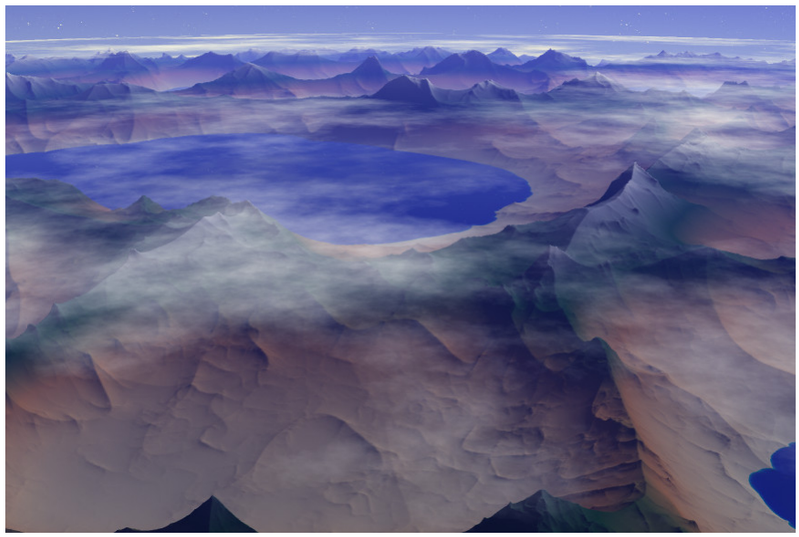
You may notice that MojoWorld is rendering more slowly now than it was in the beginning. That's because is has much more work to do now, evaluating all the textures we've created. Getting down close to the surface also slows things down, as there are more levels of detail required to image everything at pixel-level detail. It's not easy to pull this off; MojoWorld has a lot of work to do to image even this very simple world we've created.

Epilog

We've built a new planet entirely from scratch. We didn't get into exploring it, but it's there, waiting. It's a very simple planet and not all that interesting as MojoWorlds go, as this shot from deep space illustrates:



Down a lot closer to the surface, though, it's more interesting:



Simple as this planet is, I think it's pretty darn cool that it was built with relatively little effort—for a whole Earth-sized planet!

As much work as we did, we barely scratched the surface of MojoWorld's capabilities, most of which have yet to be explored and exploited by *anyone* at the time of this writing, three years after the introduction of MojoWorld Generator 1.0.

I've been working towards MojoWorld rather single-mindedly since 1987. In all that time of plotting and planning, I never anticipated just how much work it would take to create a really *interesting* planet the size of Earth. It's such a big job that, even only six months after the introduction of MojoWorld Generator, I can hardly imagine starting a new planet entirely from scratch. I'd always start with an existing planet that I like and make modifications to it. (MojoWorld Generator has a **Planet Info** feature in the **File** menu that lets us track authorship and changes to MojoWorld files. I expect that a few years from now, the really interesting planets will have a list of people who've contributed to their beauty.)

At any rate, expect it to take some time to build interesting, original planets of your own. Heck, it always took me many days of work to generate just one nice still image of a relatively small "stage set," in my years of creating proto-MojoWorld artworks. MojoWorlds are far more than beautiful, static images—they are full planets that may be home to countless beautiful images, all just waiting to be discovered. MojoWorld is the first 3D graphics application that deals with more than strictly local "stage sets." Only MojoWorld takes the global view. MojoWorlds are huge places and should be varied. Introducing these variations will take lots of work, no doubt about it. But the results can be positively mind-bending. (See Armands Auseklis' MojoWorld Galleries for some of my favorites.)

You're probably using the free MojoWorld Generator Demo when you're reading this. If you get hooked and feel the need to be the creator of your own entirely new planets, please buy MojoWorld Generator and support Pandromeda's ongoing efforts to refine and improve the tools that open up the Mojoverse to all Earthlings.

Welcome aboard, Mojonaut! We hope you enjoy the adventure. And don't forget to share with the rest of us the beauty you discover in your images, animations and QTVR panoramas. Remember that MojoWorld files are generally amazingly compact, so pick them up freely over the Internet and share in the adventure of exploring this parallel universe we call the Mojoverse.

-Doc Mojo Musgrave, Oct 14, 2004

What is MojoWorld?

MojoWorld is planet building software from Pandromeda, Inc., the leader in virtual world creation. It provides unprecedented power, flexibility, and control with some of the most advanced models of natural phenomena ever seen in any computer graphics application. MojoWorld also provides an excellent, user-friendly introduction to the complex discipline of 3D graphics.

In this section, you'll find:

- An explanation of the various modes (or interfaces) of MojoWorld
- Tips on moving around in MojoWorld
- A simple tutorial to help you build your first world
- An introduction to Layout Mode

Note — this section is meant to give you a brief overview of MojoWorld so you can jump right in and get started. To really understand the program, you need to read the manual!

The Interfaces of MojoWorld

Viewer
The Viewer is our simplest user interface for exploring and rendering MojoWorlds. It can and does stand alone as our free Viewer application, which you've probably already tried. For a more detailed explanation of Viewer (and for more tutorials) see the Viewer section.

Generator
Generator is where you get to create your own MojoWorlds — it's all about editing planets. To get to Generator, choose File > Go To Generator.

The Generator mode or interface consists of a set of editor windows, which look similar and work in similar ways, all of which are described in great detail in the Generator section. The detailed tutorials in the Generator section of help files and the printed manual will build your knowledge of these editors and examine the rendering process.

Layout
This is the newest mode of MojoWorld, and it's the easiest way for new users to jump in and get started. This mode purposely limits most editing and adjustments and provides an intuitive working environment that allows you to create beautiful imagery right out of the box. The mode provides a limited toolset, clearly worded explanations of specific steps and tools, and easy output of the completed image. For advanced 3D professionals, this mode provides a new layout paradigm that can increase productivity. You can open a previously created world and quickly tweak a view to produce a new scene. See the Layout section for more information.

MojoGraph
The MojoGraph™ function graph editor is only available in MojoWorld Pro. It is a way to get in “under the hood” of MojoWorld and create textures of practically unlimited complexity. It's a user interface

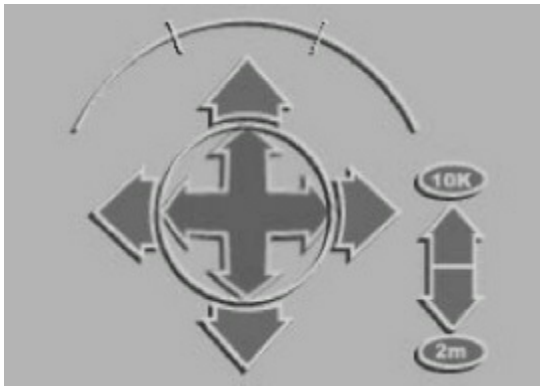
designed for digital effects professionals. We created it because our staff comes from the Hollywood special effects industry and we don't want restricted access to MojoWorld's full power. But even in the top Hollywood effects houses there are very few people who know how to use a tool this advanced. Don't worry if you have trouble making sense of it — it's a very advanced mode; something for you to grow into as you become a truly expert user.

Moving Around in MojoWorld

The large window which makes up most of the Generator main interface is where you view the MojoWorld. It is called the Real Time Renderer, or RTR for short. The RTR responds to mouse drags and to keyboard motion commands common to many video games.

The easiest way to move around a MojoWorld is with the JogNav. It's a small, semi-trans-parent trackball control docked in the center of the bottom edge of the RTR. After you build your first world (following the steps in the tutorial in this section), you should explore it a bit with the JogNav. (The basics of using the JogNav can be found in the Viewer section.)

You can also move around any MojoWorld by choosing one of the locomotion modes — Walk, Fly, or UFO. Select a locomotion mode by clicking on the icon or using a keystroke. (See the Viewer section for a more detailed explanation of locomotion modes).



The JogNav trackball makes moving around your MojoWorld easy

RandomCam

The RandomCam is another great way to navigate a MojoWorld.

The RandomCam tools allow you to explore your world in a series of random jumps. When you find an interesting view, you can add it to the RandomCam ViewStack. Both the Layout and Generator sections of this manual offer more information on the RandomCam and its tools.

Now that you know a bit about what MojoWorld does and how to move around in the interface, you need to build a world and explore it!

Building Your First World – a short tutorial

If you want a great start on understanding the MojoWorld interface and exploration modes, start with the Viewer section. It's fairly short, it covers the basics, and you'll learn how to fly around a planet and make a short movie.

If you want to jump in and build your first world, follow the steps below.

1. Launch MojoWorld and choose File > New using Planet Wizard.

You'll see eight slots across the top of the Planet Wizard. The elements in these slots allow you to choose everything you need to create your world. The six-pip randomize button causes the Wizard to choose a random preset for all eight elements. The clear X causes the Wizard to remove all presets from all eight elements. Click the randomize button once and see what you get.

See more about the Planet Wizard

2. After you've chosen all of the elements that make up your world, take a look at the Zip Render window below the Element icons. It will give you a good idea of what your world will look like. Don't like the view? Use one of the randomizer dice to pick a new one. Click the two-pip die to see a slightly different location or the six-pip die for a totally new view.

   Tip
   The Zip Render window defaults to starting out at airplane-like altitudes of around 10 km. Click the airplane Fly icon to go up to UFO altitudes, or about 500 km. Click the UFO icon to jump down to around 5 meters, represented by the Walk icon. All subsequent random jumps will happen in the specified altitude range until the icon is changed.

3. When you find a view you like, click OK. Then choose File > Save. (When a saving a new world file for the first time, you'll get the Library Exporter dialog. The options of the Library Exporter are explained in detail in the Library section.)

You've just made your first MojoWorld. Now you can explore it and have some fun!

The Eight Planet Wizard Elements

These are the pieces from which the Wizard builds a new MojoWorld.

The Land Texture determines the shape of the planet's surface.

The Land Material determines the coloring of the planet's surface and may add
some additional shaping.

The Water element adds an ocean to the planet and determines its appearance.

The Sun element chooses from a variety of preset Suns (some of which may have
intense colors of lighting, causing the other elements to react very differently than their thumbnails indicate).

The Moon element adds a single moon. More moons may be added in Generator
later, but the Planet Wizard will only allow for either a single moon or no moon.

The Stars element provides stars and other celestial backdrop features, such
as nebulae.

The Rings element adds planetary rings.

Finally, the Atmosphere element provides the atmospheric effects and cloud cover (which may hide the sun, moon, stars, and rings, so that's why it's here in
the last slot!).

Each Element's slot is topped with a large Icon type indicator. Next, each Element has its own individual Random / Clear buttons. Next, each Element has its own individual Randomize and Clear buttons. The Randomize button will choose a random item from the Library associated with that Element.

Tip

A default Sun and Sunlight source will be included in the new planet even if the Sun Element is left empty.

The lower part of each Element's slot will show a Load From Disk icon if the slot is currently empty, or it will show the thumbnail of the selected preset if the slot is currently assigned. Clicking on the Load From Disk / Thumbnail section of an Element's slot will open the Library Loader dialog to view the Library associated with that Element. (To learn more about Libraries and the Planet Wizard, see the Planet Wizard/Library section.)

Exploring Your World

You can move around your world using any of the locomotion modes described earlier in this section. If you want to hop around the planet quickly, try the Random Cam.

The RandomCam tab is at the bottom right of the RTR. Clicking the six-pip die makes a large change, putting the camera almost anywhere on the lit side of the planet; clicking the two-pip die puts the camera somewhat close to its original position. Click the plus icon to add the current view to the RandomCam's ViewStack.

Tip

Clicking on a thumbnail in the RandomCam ViewStack takes your camera back to that location.

For more about the RandomCam, see the Generator section.

Use the JogNav to walk around your world and explore it in detail. The JogNav is always active; to access it, hover your mouse pointer over the JogNav tab (centered beneath the RTR). The trackball disappears if you move your pointer away; while you're learning to use it, you may want to keep it visible. Just click the circle lock open widget (the dash inside a circle) in the tab; the dash will turn into an up arrow and the trackball will remain visible.

WARNING:The RandomCam ViewStack will be emptied if any change is made to the planet, such as changing the Time of Day, or adding any objects! To make a more permanent record of these locations, you may shift-click the thumbnail to add a camera at that location.

Rotating the central trackball of the JogNav turns your point of view (really the camera's point of view) to the left and right as well as

pitching it up and down. Double-clicking the trackball levels the camera.

Surrounding the trackball are four arrows; holding the mouse down on any of these arrows will move the camera in that direction. To the left of the trackball are two targets. Clicking the 10K target places the camera level at an altitude of 10 kilometers. Clicking the 2m target places the camera level at an altitude of 2 meters (about the height of a tall human).

Tip

If you want to slow the motion of the camera while using the JogNav, press the shift key.

Additional functions of the JogNav are explained in detail in the Viewer and Generator sections.

Adding Objects to Your World

You've found a view or two that you like. Now you can add objects to your world to make it more interesting. Creating a PhotoBillboard is a fast and easy way to add an item to your world.

And, as you'll want to render a scene after you add an object, we'll take you into Layout Mode for this portion of the project. Choose File > Go to Layout Mode (or command/ctrl-L).

Layout Mode manages items with a series of tabbed palettes, and opens with the Snapshot palette active. If you're happy with your current view, click the Objects tab to move on. (If you'd like to choose a different view, you can move around by clicking the six- or two-pip die icons. Click the Save Current View button to add this view to the Snapshots scrolling list.)

In the Objects palette, click the Create PhotoBillboard icon; a Library Importer dialog will appear.

Choose the file named “Man-holding-blank-sign.png” from the Library Importer dialog that appears, then click OK. Use your cursor to position the item, then click to place it.

Tip

Drag with the mouse when placing PhotoBillboards, then use their bounding box handles to resize. (When you place a PhotoBillboard with a simple click, it's created with no size, which makes it difficult to work with.)

If your PhotoBillboard is floating in the air (or worse, submerged in the terrain), just type a 'g' or click the Drop button below the rotate tool. You'll see two icons — an open

lock and a yin yang symbol. Click the lock icon to lock the item into position facing the camera. Click the yin yang symbol to invert the alpha channel of the image (this determines which areas of the image are transparent).

If you want to reposition the item, hover your mouse over the center of the PhotoBillboard until an X icon appears. Drag the X icon to move the item. If you want to remove it from the world and start over, click the x icon next to the PhotoBillboard's name in the Object palette.

You may notice that the Objects tab also offers Lightning, Boulders, and so on. You can add these items to your scene, but it will increase render time. These options are discussed in detail in the Layout section.

Adding Your Own Images to MojoWorld

You'll probably have more fun adding a picture of yourself (or your mom, or your lizard, or your kid, or what have you) to your MojoWorld. Try it — it's easy!

There are several options:

1. You can drag your image files into the PhotoBillboards folder (found in the application's Libraries folder).
2. You can click the Load from Disk icon in the Library importer dialog box, then find and select your image.
3. You can click the “go up a folder” icon or the “pick a new folder” icon, then get your image.

Rendering an Image

After you've placed and positioned a PhotoBillboard into your scene, you can render it and send it to your friends, family, or other Mojonauts.

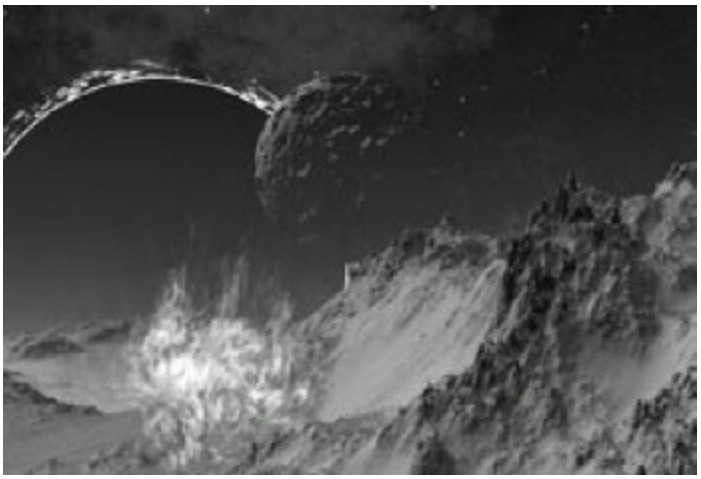
In Layout Mode, click the Render tab and choose Multimedia, select Wallpaper, and make sure that Reflections and Shadows are not enabled (enabling them will increase Render time). These settings will give you a low-res image in a fairly short time.

Note — MojoWorld offers almost unlimited rendering resolution. The settings are limited in Layout Mode to decrease render time. See the Render Settings Editor section of the Generator section for an in-depth explanation of Render Options.

The resulting image will look something like this:

This is only an approximation, as your planet may be composed of any of the elements available in the Planet Wizard.

Here's an example of what an experienced Mojonaut can do with a PhotoBillboard:



That's it! You've made your first world, added an element, and rendered an image. Pretty simple, wasn't it? Next you should explore the Viewer and Layout sections of the manual or the help files and follow their tutorials. You'll be making beautifully complex worlds in no time!

Welcome to Viewer

The Viewer is MojoWorld's simplest user interface. It allows you to explore a MojoWorld planet, save your favorite destinations, change the time of day and year, make movies and QTVR panoramas, render scenes, and record travelogues to share with the MojoWorld online community. The Viewer Interface in MojoWorld, Standard, and Pro is essentially the same interface as the free MojoWorld Viewer, but with some extra functionality.

In this section, you'll learn about:
• The Viewer Interface and its tools
• Moving around and exploring MojoWorlds
• Flying (via a simple tutorial)
• Altering time, recording movies, rendering images, and more

This section begins with a brief overview of all of the tools in the immediately visible interface screen.

The second section explains how to explore MojoWorld using a variety of motion Modes including our new JogNav tool. A flying tutorial is included to get you going as soon as possible.

The third section describes the Panel Tools. These allow you to save planet settings, alter time, record travelogues, record movies, render images, and pinpoint your location on the planet's surface.

Many of the tools and concepts that you learn in the Viewer Interface will assist you greatly when you move on to the Layout and Generator Interfaces.

How to get to Viewer

MojoWorld Standard and the free MojoWorld Viewer will launch into the Viewer Interface. To get to the Viewer Interface in MojoWorld Standard or Pro, choose Menu Bar>File>Go To Viewer.

Overview of the Viewer Interface

Menu Bar
The menu bar consists of two menus, the File menu and the Help menu.

File Menu

New with Planet Wizard...
Allows you to create planets quickly and easily, using a variety of presets. For more about the Planet Wizard, see the Planet Wizard and Library section of the manual.

Open…
Opens the standard file dialog for opening MojoWorld files. (*.mjw)

Open using browser…
This option opens the Planet Library Browser for .mjw files. The home folder is the Planets sub-folder of the main Libraries folder. See the Library section of the manual for a more complete description of the Libraries folder structure and how to use Library Browser dialogs.

Save

Saves your current MojoWorld to disk. If the current MojoWorld has not been assigned a name, the Library Exporter opens as described in the Save As… option.

Save As…
This option opens the Library Exporter associated with the Planet. The Library Exporter allows you to create or load a preview image and to write a text description of your planet. A complete description of how to use the Library Exporter can be found in the Library section.

Info
This option opens a dialog with important tech support info about your version of MojoWorld and your video drivers. You will need the information from this dialog when contacting Pandromeda technical support.

Planet Info…
This option displays information about the author for the current planet. You may add to the text by selecting the same option in the File Menu of the Generator Interface.

Go to Generator
This option takes you into the Generator interface.

Quit
Quits the application. If you Quit out of the Viewer interface from MojoWorld Standard or Pro, the next time you launch it, you will be in the Generator interface.

Help Menu

QuickStart Tutorial…
This option opens a page in your web browser that provides useful information on the basic functionality of the Viewer Interface via a short tutorial. Simply follow the instructions that appear on this page.

Viewer Quick Reference…
This option opens a page in your web browser that provides basic instructions on moving around, recording and playing movies, rendering, and using the various panels in the Viewer Interface.

Viewer Online Help…
This option opens the Pandromeda “Help: Starting Points” page in your web browser. Your computer must have internet access to use this option.

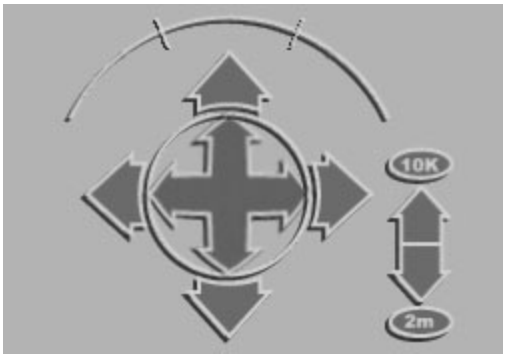
About MojoWorld…
Brings up a dialog listing the MojoWorld development team members.

RTR Window (RTR)
The large window in which you can view the planet surface is called the Real Time Render (RTR) window. It displays the view of the camera while you navigate around the planet, or it will display a still image render after you have clicked on the camera button to render the current scene. It also displays the progress of a single render or of the render queue while actively rendering.

The JogNav Panel

The JogNav provides an onscreen method for moving around your MojoWorld. It is always active in Walk mode, and it is always hidden in Fly or UFO modes.

The JogNav has a central trackball. Rotating the trackball turns the camera to the left and right as well as pitching the camera up and down. Holding down the Alt key will cause the trackball to have a pair of curved arrows in it. While in this configuration, the trackball controls the camera tilt. None of these motions will change the location of the camera, they only affect the camera's orientation in space.



The JogNav trackball in its default state

Tip

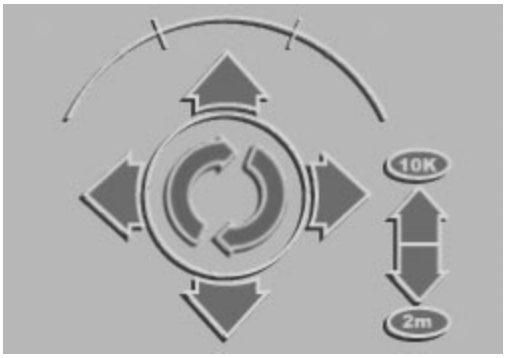
Double-clicking the trackball levels the camera.

Surrounding the trackball are four flat arrows. Holding the mouse down on any of the four flat arrows will change the camera's location by moving it in the indicated direction. The top arrow moves the camera forward, the bottom arrow moves the camera backward. The left and right flat arrows move the camera to the left and right. These

motions are much like Walk mode. As in Walk mode, the speed of motion depends on the camera's altitude above the planet's surface; holding the shift key down while pressing on one of the flat arrows will slow the camera's motion.

To the right of the trackball is a double-ended vertical arrow. Holding the mouse down on the upper portion of the vertical arrow will move the camera to higher altitudes, and similarly, holding the mouse down on the lower portion of the vertical arrow will move the camera toward the ground until the mouse is released or the minimum altitude of 1.0 meters is reached. At the top and bottom of the vertical arrow are two targets, one labeled 10K and the other labeled 2m. Clicking in the 10K target will place the camera level at an altitude of 10 kilometers. (This is the same as the 'b' keyboard shortcut.) Clicking in the 2m target will place the camera level at an altitude of 2 meters, which is about the height of a tall human.

Arcing over the top of the JogNav is a camera Field of View control. Drag to the left to narrow the field of view. Drag to the right to widen the field of view. This control has the effect of zooming in or out, but does not move the camera from its current location.



In this mode, the JogNav controls the camera tilt. Hold the Alt key to switch to camera tilt mode.

View Pane Control Bar

The ViewPane Control Bar is immediately below the RTR Window. It contains the tools for exploration and rendering. When the current scene is being rendered the ViewPane Control Bar becomes the Rendering Status Bar (see the section on the Rendering Status Bar in this section). This is indicated by a change in the color of the toolbar from gray to black.

Items in the ViewPane Control Bar are as follows:

Preview Style
This drop-down list box changes the display in the RTR between Textured, Textured with Clouds, or Wireframe. Wireframe is faster and can provide smoother animation.

Walk Mode (Red when selected)
Allows leisurely exploration via controls on the keyboard. For a list of the controls see the Exploration section of this chapter. In Walk Mode, the camera follows the contours of the terrain. Walk Mode is an easy way to explore a MojoWorld.

Fly Mode (Red when selected)
Allows smooth camera motion above the terrain that simulates flying. The mouse controls most of the navigation. Unlike Walk Mode, the contours of the terrain do not affect the camera. When you fly level your path follows the curvature of the planet. Fly Mode is there to provide smooth camera paths for animations.

UFO Mode (Red when selected)
Very much like Fly Mode, but your speed depends upon your altitude. The further from the planet you are, the faster you go. UFO Mode is there for making animated zooms in and out from planets.

Pause Button
If you click “Pause” on the ViewPane Control Bar, the RTR Window freezes. All camera motion stops, and the view stops rendering in real-time. This option allows you to free up CPU time if you want to switch between applications. When the RTR Window is paused, an icon appears in the top left corner of the paused window. To restart the RTR Window, simply click on the Jump button immediately to the right of the Pause Button.

Jump Button
The Jump Button restarts the RTR Window after it has been paused. The Jump logo is white when the RTR is active.

Crop Window (Red when selected)
The Crop Window limits the size of a render. Clicking this button opens the Crop Window in the top left-hand corner of the RTR Window. You can position this window anywhere on the RTR Window by dragging on the ‘Crop’ text label centered on the crop window’s top edge, and you can resize the Crop Window using the resizing boxes in the upper left and lower right corners. (The resizing boxes will turn red as you mouse over them.) Once the Crop Window is in position, you can click on the Camera icon to render only the part of the scene displayed in the Crop Window.

In the lower left corner of the crop window is a small magnifying glass icon. This is the Crop Zoom tool. Clicking the magnifying glass will change your camera’s Field of View to zoom in on the area defined by the Crop Window. When zoomed in, the magnifying glass turns red. Clicking the red magnifying glass restores the view to as it was before the zoom. Making any other change to the view (moving the crop window, rendering the scene, moving the camera) accepts the zoom change and the magnifying glass icon changes back to white.

Camera
The camera button starts a photo-realistic render of the current

scene at the render quality selected in the Render Options Menu (the default quality setting is Medium). You should select options in the Render Options Menu before beginning a render of the current scene. When the Viewer Interface renders a scene the ViewPane Control Bar turns black, and displays a different set of controls. This new control bar is called the Rendering Status Bar and it is described after the Render Options Menu.

Render Options Menu

Low, Medium, Normal, High, and Maximum

These are the render quality settings. Medium is the default. The Low and Medium render settings use no shadows. The Normal and High render settings use Fast Shadows. The Maximum setting uses Full Shadows. See the section of the Generator chapter on defining render settings for a complete explanation of the differences between the shadow render modes. As the quality of the render increases the images show more detail, and the render time increases.

Render QTVR Now…

Lets you render QuickTime Virtual Reality (QTVR) panoramas. You can view these using the QuickTime player included on the MojoWorld CDs. If you save the rendering as a .mov file, MojoWorld renders six two-dimensional images (on the faces of a cube centered around the camera) and merges them into a QTVR panorama. If you save the images as PNG or other still image format, the QTVR selection renders the same six images and saves them as separate sequentially numbered still image files. For examples of QTVR panoramas visit the Pandromeda website,

www.pandromeda.com. For more information regarding QuickTime visit the Apple website, www.apple.com.

Add to Log...
This selection creates a new log entry for the current view. See the section on the Log Panel later in this chapter for more details.

Process Later...
This selection creates a new Uplink Queue entry for the current view. See the section on the Uplink Queue Panel later in this chapter for more details.

Rendering

In MojoWorld, there are two ways to view the planet, either in the RTR, or using the photo-realistic Renderer. The RTR is designed for interactive exploration. It's always real-time, and it's always drawing the world as fast as it can. Because MojoWorlds are so complex, it can only render an approximation of what the final planet will look like. However, if you stop exploring and give it more time to work, that approximation will get better and better, and will end up showing a fairly accurate view of the planet.

There are some things the RTR can't display though, including many atmospheric effects, and the really fine detail that make MojoWorlds so fascinating. To see these effects, you must use the photo-realistic renderer. This renderer doesn't work in real time, and is a lot slower than the RTR. However, it can capture the detail of every feature of the planet, down to the size of a single pixel in the image, or even smaller, if you want. The different render settings for the photo-realistic renderer tell it how much detail to show.

As you increase these settings, the renderer will take longer to create the image, but will examine the planet ever closer, finding every nook and cranny that can be seen and capturing every detail in the textures. For large renderings of complex planets this rendering can take quite a long time, but by using the Uplink Queue you can get MojoWorld to do the rendering while you catch up on your sleep.

Render Status Bar

This toolbar contains the tools to save, pause, and close the render display. The render status and progress is displayed beneath the Render Status Bar.

A rendering of a still image or a single frame of a movie goes through specific phases. These phases are reported in the Rendering status area. The phases are:

> **Starting Render** – Unless the world file is very complex, this phase goes by very quickly.
>
> **Pre-processing** – In this phase, the terrain is being computed and diced up into manageable chunks for the render.

Tip

Users often ask why the status doesn't include an estimate on the portion of pre-processing completed, but unfortunately, that's not possible. If you think of the pre-processing stage as akin to removing a piece of string from a pile of junk, the question of estimating the string's length is the same sort of problem. The string cannot be measured until it is taken out of the junk, but that was the task to complete in the first place!

> **Rendering** – The main phase of rendering an image. The rendering process creates the image in columns starting from the lower left corner and proceeding to the upper right. The row of orange dots in the Status Bar fills in as each 10 percent of the image is rendered.

Redoing Blocks – As the render progresses, it flags 'problem' blocks that may need to be redone due to missing terrain. Sometimes these missing bits are very small, only a pixel or two. Other times the missing parts can encompass most, or even all of a block. This second pass runs from the upper right to the lower left, although not in as orderly a fashion as in the first render pass. Also, the percentage completed is not a percentage of the whole image but only of those blocks that were flagged as problem blocks. Often there is no visible change to the image during this process, but the renderer still performs this pass just to be sure. This portion of the render process is skipped in the Low and Medium render quality settings.

Tidying – This part runs very quickly and does some behind-the-scenes cleanup of memory used during rendering.

Render Completed – This indicates that the render is done. When rendering with shadows disabled (shadows may be manually enabled or disabled in the Uplink Queue regardless of the current render quality setting's shadows parameter) these phases are followed in an orderly manner. When rendering with shadows on, these phases are often all jumbled together and may appear to be repeating. This is normal behavior for the Rendering status area.

Tip

When rendering with shadows disabled (shadows may be manually enabled or disabled in the Uplink Queue regardless of the current render quality setting's shadows parameter) these phases are followed in an orderly manner. When rendering with shadows on, these phases are often all jumbled together
and may appear to be repeating. This is normal behavior for the Rendering status area.

Save to File

Opens a Save dialog to save the currently displayed rendered image. This saves the image as a PNG file by default. Other options include BMP, JPEG, TGA, and TIFF. Saving this file saves only the rendered image not the MojoWorld (.mjw) file.

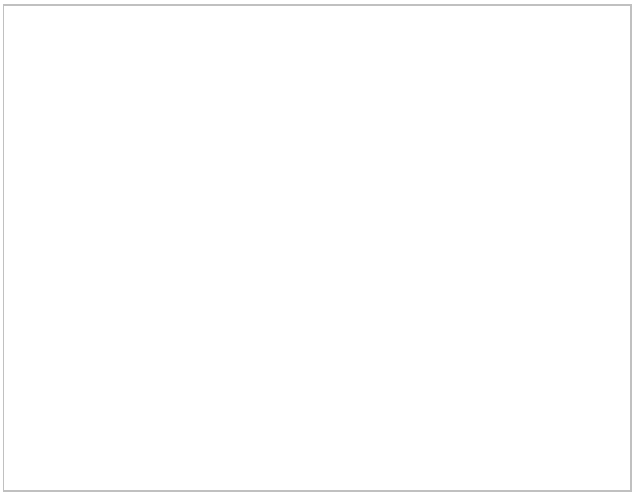
Pause Icon
Pauses the current rendering. The icon turns red when the rendering is paused. To restart the rendering click the Pause Icon again.

Close icon
Closes and cancels the currently displayed render and returns to the Viewer Interface. You will be prompted to save the rendered image.

IMPORTANT NOTE: No tools outside the Render Status Bar will function until the current render is closed.

Hyperspace Mixer

The area below the ViewPane Control Bar contains the Hyperspace Mixer. The Hyperspace Mixer may contain a set of orange sliders which change elements of the planet according to the specifications of the author of that element. A world may have none, one, a few, or very many Hyperspace Mixer sliders. A single Hyperspace Slider is moved by dragging on the white dot at the tip. All of the sliders may be moved at the same time with the Randomize tools.



Randomize
You can randomize the slider settings by clicking on either of the dice. The die showing two pips will induce only a small amount of random change on each slider. The die showing six pips can cause very large changes in the positions of each slider.

There may or may not be immediate visual feedback of what the slider has done, depending on if the element of the MojoWorld it affects is rendered in the RTR. For example, a change in ‘Star Intensity’ will not be displayed in the RTR, as the star backdrop does not render in any preview mode. A change in ‘Cloud Density’ may or may not be displayed in the RTR, depending on whether the ‘Textured with Clouds’ preview mode is selected. A change in ‘Mountain Height’ will

be displayed in the RTR when the slider is released. A change in ‘Moon Size’ may actually show the moon wireframe expanding or contracting in the RTR as the slider is being moved. These sliders are just examples of possible controls that may be available; the actual set of sliders available will vary from planet to planet. Since Hyperspace Mixer sliders are written by artists, the names of these sliders may be anything.

Tip

The authors of sliders can also add Tool Tip help text, so hover your mouse pointer over the slider’s name to make that text appear.

Panel Toolbar

Below and to the right of the RTR Window is the panel toolbar. When a toolbar icon is selected the corresponding control panel appears in the area directly below the Panel Toolbar.

Settings Panel
Save and manage a list of named Hyperspace Mixer slider combinations.

Time
Change the time of day and the season of the year.

Log
Save and manage a list of named hyperspace coordinates with comments. Coordinates include the location of the camera, time settings and Hyperspace Mixer slider configuration. A log entry may also contain a Movie.

Movie
Record and playback a path as you walk or fly around the planet.

Uplink Queue
This queue manages render jobs. It allows many renders to be queued up for automatic, unattended processing.

Navigation Console
This panel provides tools to assist your in you travels around the planet. There is a compass and displays for pitch, roll, horizon and altitude, useful in Fly Mode. The GPS (Global Positioning System) graphically displays your location on the planet surface.

Exploration

In addition to the JogNav tool described in this section, you can explore using the keyboard and mouse. Select an exploration Mode by clicking one of the three motion icons, Walk, Fly, or UFO, or by using the keyboard shortcuts listed in the Appendix.

See Walk Mode

See Fly Mode

See UFO Mode

See Controls for Fly & UFO Modes

See Flying Tutorial

Walk Mode

Walk Mode allows you to move around the surface of a MojoWorld in a leisurely manner. The camera follows the contours of the terrain at a fixed height above it, as if you were walking on stilts. In Walk Mode your speed increases with altitude, so if you really want to get around the planet quickly, go up high, and if you want fine control, get down low.

Tip

To move slowly in Walk mode, depress the shift key while using any of the Walk mode directional keys.

To look around in Walk Mode drag the mouse (left-click is slow; right-click is fast) in the RTR Window. Mac Users: To look around quickly in Walk Mode, hold down the Control key while dragging the mouse.

The primary controls are on the keyboard:
m Up
n Down
q Tilt left
e Tilt right

w ↑ Forward
s ↓ Backward
a ← Left
d ← Right

The JogNav trackball also allows you to turn and pitch in place.

You can also turn and pitch the camera in the RTR using the Navigation Console on the Panel Toolbar. Just drag on the compass and artificial horizon with the mouse.

Fly Mode

Fly Mode allows you to move the camera as if it were an airplane. The controls model the behavior of an airplane to enhance this experience. (It's really a little more like a helicopter, as you can hover.) There is some specialized terminology associated with flight; definitions of terms such as "roll, "pitch," "yaw," and "crabbing" appear in the Glossary of this manual.

Using Fly Mode can be quite challenging, at first. After reading about the controls below, you may wish to go to the Flying Tutorial to get some basic instruction.

Keep in mind that the Fly and UFO modes are there more for laying down smooth camera animation paths than for getting around in MojoWorlds. But flying around for its own sake can be endless fun, too!

There are three sensitivity modes for the controls in Fly and UFO Modes:

Gentle
The controls respond gently and your top speed is limited. This is the best Mode for your first flights. If you take your hands off the controls, you will automatically return to a straight and level flight path.

Intermediate
The controls are more responsive. There is only moderate auto-leveling if you take your hands off the controls.

Extreme
The controls are very responsive. There is no auto-leveling. This Mode simulates a VSTOL (vertical/short take-off and landing) jet fighter.
Right-click (Mac users: control-click) the Fly or UFO icons to

bring up the mode selection menu.

UFO Mode

UFO Mode is very similar to Fly Mode, except that the velocity of the camera is dependent on its altitude above the planet. Also, the camera does not track the horizon in straight and level flight, rather, it will fly off into space. This Mode is useful for making smooth animations in which you zoom in to the planet from space. Without this Mode, you would most likely punch right through the planet when you zoomed in, because when you got close, you'd be going too fast!

Flight Controls

Controls for the Fly and UFO Modes
An important note for Macintosh Users: Since you have only one mouse button, hold the Control key down when you click to simulate the right-click. In the following section read right-click as control-click.

Panic Buttons

The Space Bar
Hitting the space bar during flight causes the camera's motion to stop instantly. The camera remains facing the direction in which it was traveling when you hit the bar. Think of the space bar as your main "panic button."

The L key
Hitting the 'l' key in flight causes the camera level out instantly. This is a useful key for recovery from over-enthusiastic maneuvering. Remember that if you are in Gentle Mode your flight path will level out smoothly if you release the controls, or "go hands-off."

The B key
Hitting the 'b' key during flight causes the camera to instantly pop to a point 10,000 meters (~30,000 feet) above the planet at your current global position. The camera will be level and stationary.

The following keys control acceleration in the various directions:
w ↑ Forward
s ↓ Backward
a ← Left
d ← Right
m Up
n Down

Forward/Reverse Velocity and Acceleration

The ‘w,’ ‘s,’ Arrow up, and Arrow down keys control camera velocity and acceleration. To accelerate forward or backward, simply depress the appropriate direction key. The longer you hold it down the faster you accelerate. Release the key when you want to maintain the current velocity.

Left and Right

The ‘a,’ ‘d,’ Left arrow, and Right arrow keys control left and right movement. To accelerate left or right, simply depress the appropriate direction key. The longer you hold it down, the faster the camera accelerates. Release the key when you want to maintain the current velocity.

Yaw

The right mouse button controls yaw, or rotation back and forth around the camera’s “up” axis. The difference between the Yaw and Left & Right controls is that Yaw rotates the camera, while the Left and Right controls cause a sideways “crabbing” motion, without such rotation.

Tip

Once you learn how to turn using the left mouse button, the Yaw control of the right mouse button becomes largely superfluous.

The Left Mouse Button

The left mouse button controls pitch and roll.

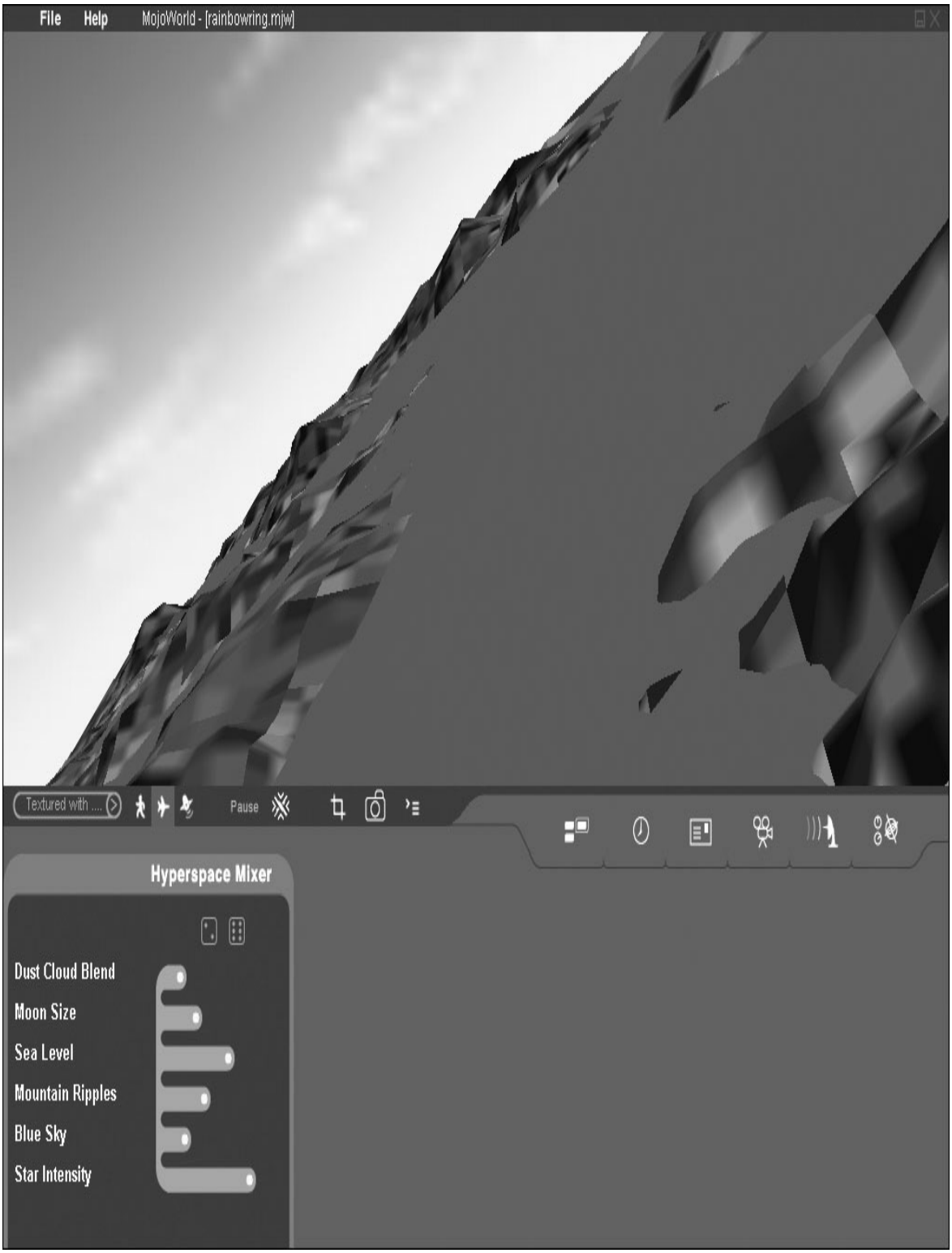
Pitch

Pitch is rotation of the camera around its left/right axis. In the airplane analogy, it is rotating the nose up and down. In terms of a moving camera, pitch points the camera up and down. Control pitch by dragging up and down with the left mouse button. The further you drag from the mouse-down point, the faster the camera pitches.

IMPORTANT NOTE: Dragging down pitches the camera up, and vice-versa. This may seem backwards at first, but that's the way real airplanes work. "Pulling back on the stick" makes you go up, and vice-versa.

Roll

Roll is clockwise/counterclockwise rotation around the axis of the direction of view. This corresponds to an airplane tilting its wings right or left, or the camera tilting right or left. Control roll by dragging right/left with the left mouse button. The further you move the cursor from the mouse-down point, the faster the camera rolls.



Turning

Turning an airplane gracefully is an acquired skill that takes some practice. To turn in Fly Mode, follow these steps:

- First start moving forward (or backward)
- Left mouse down in the RTR Window
- Roll over a little by dragging gently left or right
- Now “pull back on the stick” by dragging down gently
- Now you’re turning!
- Move gently back to the mouse down point to terminate your turn

The hardest thing about learning to fly is learning not to over-control. Use very slow and gentle mouse movements until you really know what you’re doing. Stroke the controls as smoothly and gently as you would a sleeping viper, and you’ll do just fine.

IMPORTANT NOTE: Most real airplanes are set up so that when you roll, the nose yaws over in the same direction. This causes the airplane to begin to spiral down. You maintain altitude — and turn at the same time — by pulling back on the stick. The less advanced MojoWorld flight modes work the same way.

Flying Tutorial

Putting All the Flying Controls Together: Flying Tutorial
When you combine all the above controls the motion becomes very smooth and natural, just the way you want it when you record a camera path for rendering an animation. This brief flying tutorial will help you to put the controls together. Practice for a while, and soon you will be flying like an expert without having to think about what you're doing. But remember: it does take practice, so you can expect to be out of control at first, and to take some time before you can maneuver in the way you want.

Remember your Panic Buttons: the space bar, 'l' and 'b' keys.

1. Click on the Fly Mode and select the Gentle sensitivity option.

2. Move the cursor to the middle of the RTR Window and then press and hold down the left mouse button.
Gently move the mouse left and right. This is rolling. Notice how the further you move from the mouse-down point, the faster the camera rolls. Practice this until you can return to level easily. Return the cursor to the center of the screen (you should be stationary, if not press the 'b' key), and hold the left mouse button down again. This time gently move the mouse up and down. This is how you change the pitch. Again, the further you move from the center the faster the camera moves. It is also important to note that if you move the mouse up you pitch down. The opposite is also true. If you are not familiar with flight simulators or real airplanes, this can be unsettling, but you'll quickly get used to it. Real airplanes have always worked this way.

   Press the 'b' key to reset your altitude and orientation.

3. Control velocity with the keyboard controls.
Press the 'w' key to start forward motion. Hit it again to increase your speed. If you hold the 'w' key down the camera will

accelerate rapidly — try it. In Gentle Mode, when the camera reaches a certain maximum velocity it will no longer accelerate. In Intermediate and Extreme Mode you can go much faster.

IMPORTANT NOTE: In Fly Mode, you will follow the curvature of the planet when flying level. If you fly straight and level in UFO Mode, you will fly off the planet and out into space. Try it. Notice that in UFO Mode camera speed is dependent on distance from the planet: the farther away you are, the faster you go.

Press the ‘b’ key to reset your altitude and orientation.

This time use the ‘w’ key to accelerate gently, then try to return to a stop using the ‘s’ key.

Press the ‘b’ key to reset your altitude and orientation.
Now we will put these motions together.

4. From a stationary position, increase the pitch a little so that you do not crash right into the terrain (see step 2).
Gain some initial forward velocity (see step 3).
When you are comfortable with your speed move the cursor to the middle of the RTR Window and hold the left mouse button down. Now try turning slowly to the right (if there are no mountains to crash into there!): Gently roll to the right (slowly move the mouse right). You will notice that your nose will start to drop, so compensate by increasing the pitch (moving the mouse down). To fly smoothly, keep the mouse button depressed.

When things get out of control, hit ‘b’ and start over.

5. Try a turn to the left. Then try to string some turns together. Watch out for those mountains! With practice you will be skimming over, around and between them.
Keep practicing. Use the space bar and the ‘l’ and ‘b’ keys liberally. Attaining mastery of flying generally requires tens of hours of practice. The more practice you get, the better pilot you

become. Top Gun pilots have hundreds of hours of training and practice!

See Flying Tips for more information

Flying Tips

• Start slowly

• Use slow and gentle mouse movements

• If the things get out of hand, hit the space bar or the ‘b’ or ‘l’ keys

• If you lose sight of the planet hit the ‘b’ key

• If the terrain is upside down and has changed color, you may have punched through the planet’s surface — now you’re flying inside the planet! Hit the ‘b’ key to get back above the surface

• Learn and use the Navigation Panel described in the next section

Once you are flying comfortably, chances are you will want to record and render out your first MojoWorld animation, which is about the coolest thing you can do with MojoWorld!

Viewer Panel Tools

This section deals with the control panels activated in the Panel Tools. They are explained in the order that they appear on the screen, except that the Movie panel is described before the Log panel. This is because you need to understand the Movie tools before you can make full use of the Log.

The Panel Tools are:

Settings Panel

Time Panel

Movie Panel

Log Panel

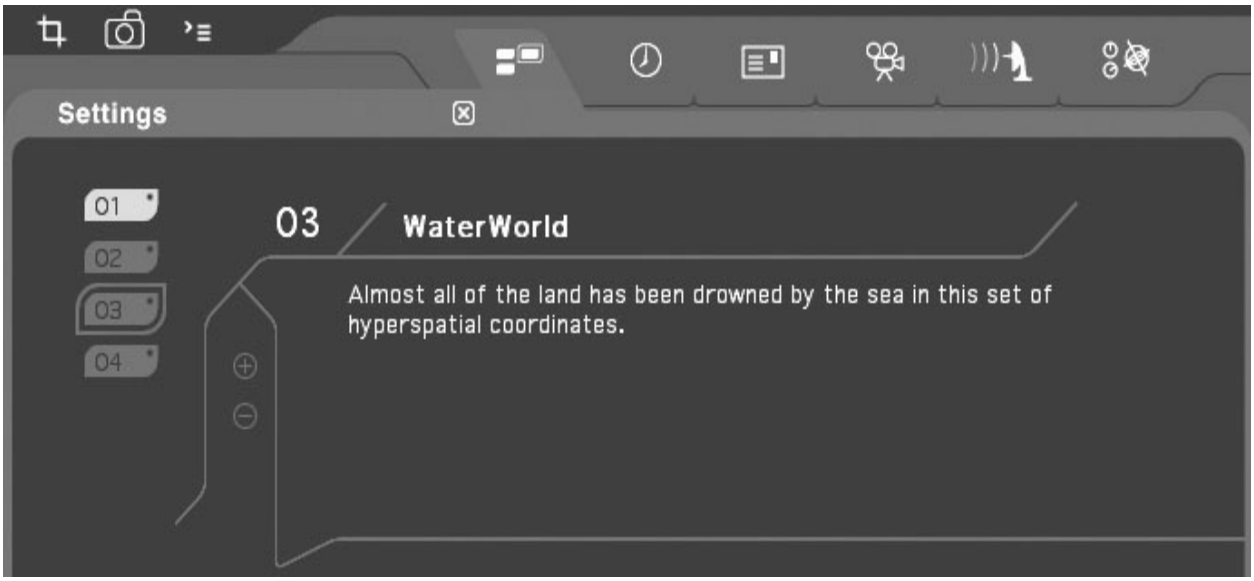
Uplink Panel

Navigation Panel

The close icon is common to all the Viewer Panels. Use it to close a panel, or simply click on another panel tool the change a panel.

Settings Panel

The Settings panel is used to save named combinations of Hyperspace Mixer slider settings. When you have settings you would like to save, open the Settings panel and click on the plus sign. A new setting will be created using the next available number. Change the default name by highlighting the title with the mouse and typing in your chosen name. Likewise, the default description of ‘Enter Description Here...’ can be changed by highlighting the area with the mouse and typing in a new description. As each new setting is added, a numbered button appears to the left of the title and description area. If there are more settings than can be shown in the list, the scroll tab on the far left will scroll the list of settings. The button corresponding to the selected setting will be outlined.

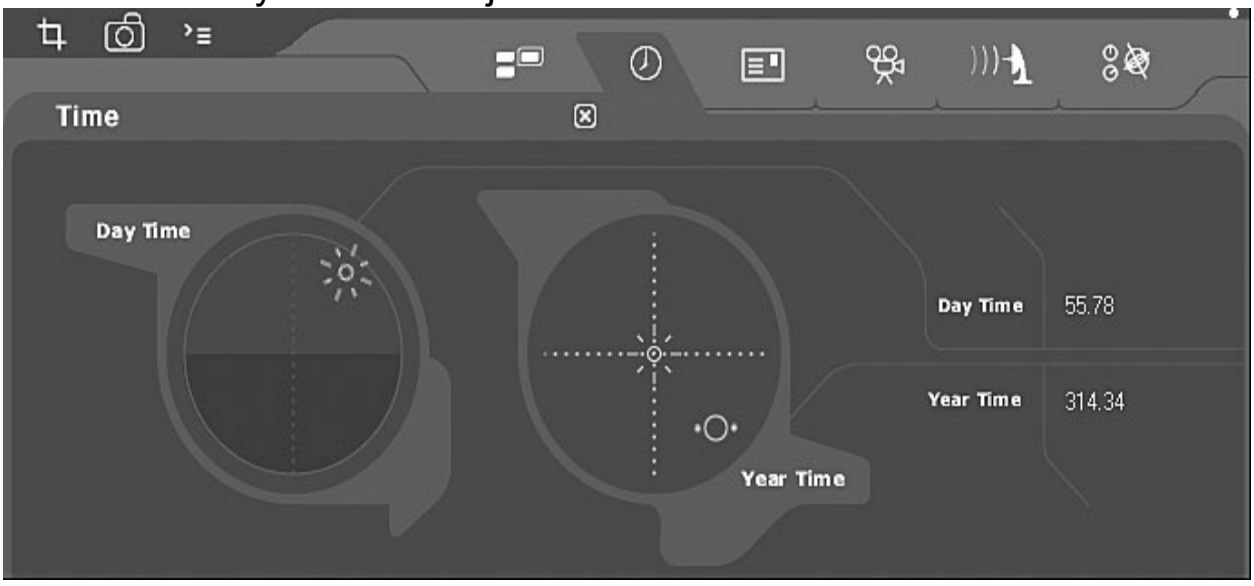


To select a new setting, click the numbered button. This will display the new slider settings in the Hyperspace Mixer area. If the Hyperspace Mixer sliders are moved after selecting or adding a setting, the Settings panel will revert back to its default state.

To delete a selected setting, click the minus sign.

Time Panel

You can use the Time panel to change the time of the day and the season of the year on a MojoWorld.



Use the Day Time Indicator to rotate the planet on its axis. From the position of the RTR Window on the planet's surface it will appear as if the sun and moon(s) revolve around the planet. As you move the sun icon around the Day Time Indicator the sun and moon(s) will rise and set in the RTR Window.

Use the Season Indicator to simulate how the seasons on the planet surface at the location of the camera change as the planet orbits the sun.

Movie Panel

The Movie panel allows you to create movies and animations. You can record the path of the camera in Walk, Fly or UFO Mode and then render out to a sequence of still frames or a QuickTime movie. Walk is the least desirable Mode for a movie because the camera follows the terrain thereby producing a “bumpy” animation that’s hard to watch. For nice, smooth animations, use the Fly or UFO Mode.

When you enter the Movie Panel for the first time, only the record button will be active. When you click the Record button, it will turn red and the Stop button becomes active. Recording will stop when either the Stop or Record buttons are clicked.

You can also use the ‘r’ and ‘t’ keys to start and stop recording.

The Timeline in the Movie Panel represents the entire duration of recording time. The ends of the Timeline can be dragged with the mouse to clip off the beginning and end of the recording. You may wish to do this to avoid recording the initial few seconds when you’re getting your animation going, or the last few seconds when the best part is over.

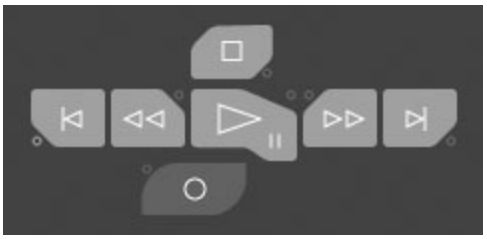
When you have recorded a movie the Movie Camera tool activates. It enables you to access a menu with the options ‘Add to Log...’ and ‘Process Later...’ these options are explained in the Log Panel and Uplink Panel sections.

The Reset button deletes the current movie and resets the panel to its original state where the only the Record Button is active and the Timeline is empty.

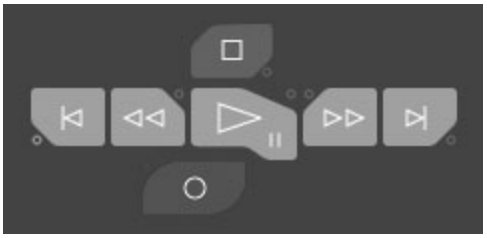
See the Movie Tutorial for more information.

Movie Tutorial

1. Open the Movie panel by clicking the Movie panel icon on the Panel bar.



2. Click the Record button



3. The Record button will turn red. The Stop button will become active.

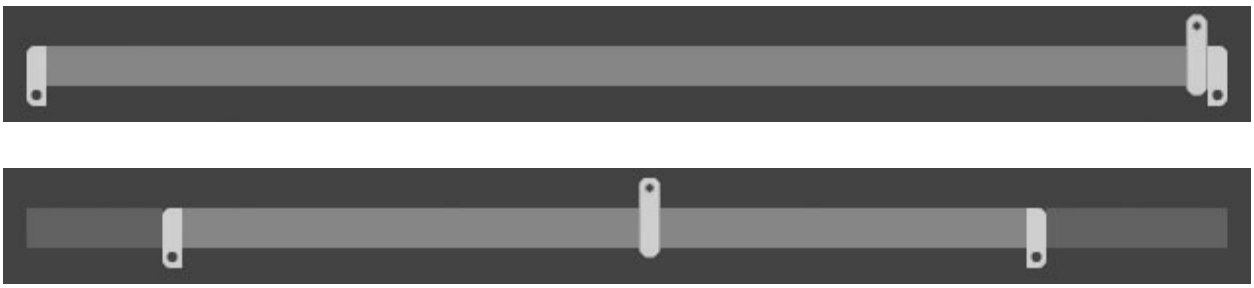
4. Explore in any desired motion Mode. When recording in Fly Mode you may prefer to start the Mode and get some forward speed before recording.

5. Click the Stop button to stop recording. All the other Movie controller buttons will become active.

6. Review the movie. Use the fast rewind button to return the slider to

the beginning. Click on the play button to play back the movie. Use the forward and reverse buttons to skip over or replay parts as you wish.

7. If you want to cut off portions of the beginning and end of the movie that you don’t like, drag the endpoints of the Timeline to shorten the range of the slider.



8. Once a timeline has been recorded, the Movie Camera icon inside the Panel activates. It enables you to access a menu with the options ‘Add to Log...’ and ‘Process Later...’ These options are explained in the following two sections.

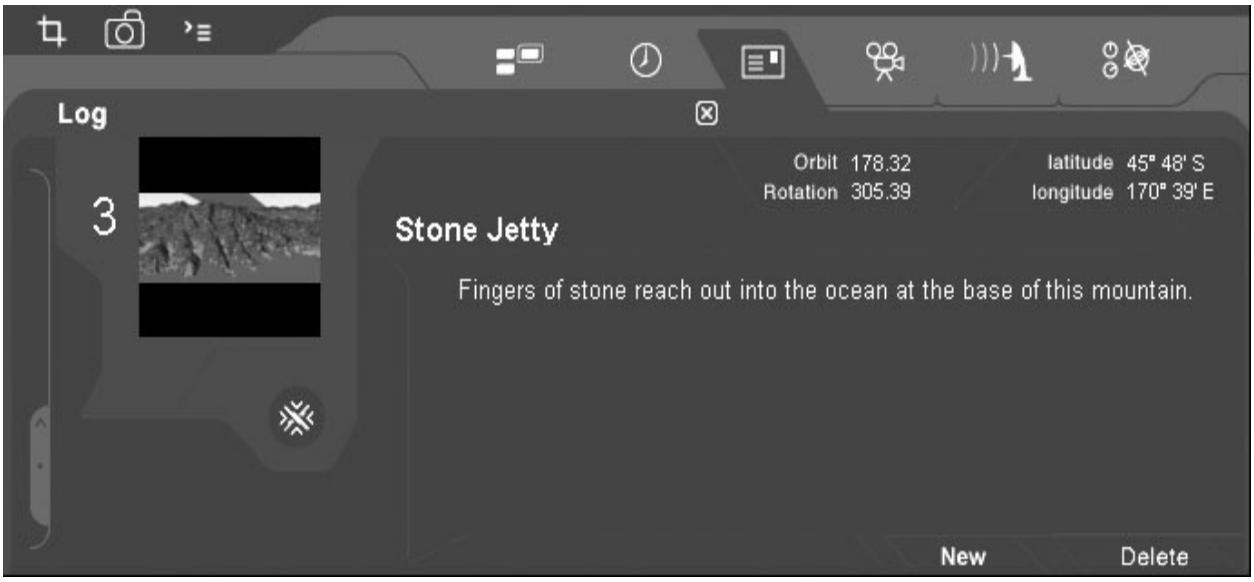
Log Panel

The Log Panel is where you can build your own MojoWorld travelogues to share with your friends in the MojoWorld community. These travelogues can include still images, movies and text. When you save a Log entry the camera position, time, and Hyperspace Mixer settings are also saved.

Use the Add button in the Log Panel to add a still image. Still images can also be saved in the log through the ‘Add to Log...’ menu item in the Render Options Menu on the ViewPane Toolbar (ViewPane Toolbar>Render Options Menu>Add to Log...). Movies can be added to the Log from the Movie Panel (Movie Panel>Movie Camera Icon>Add to Log...).

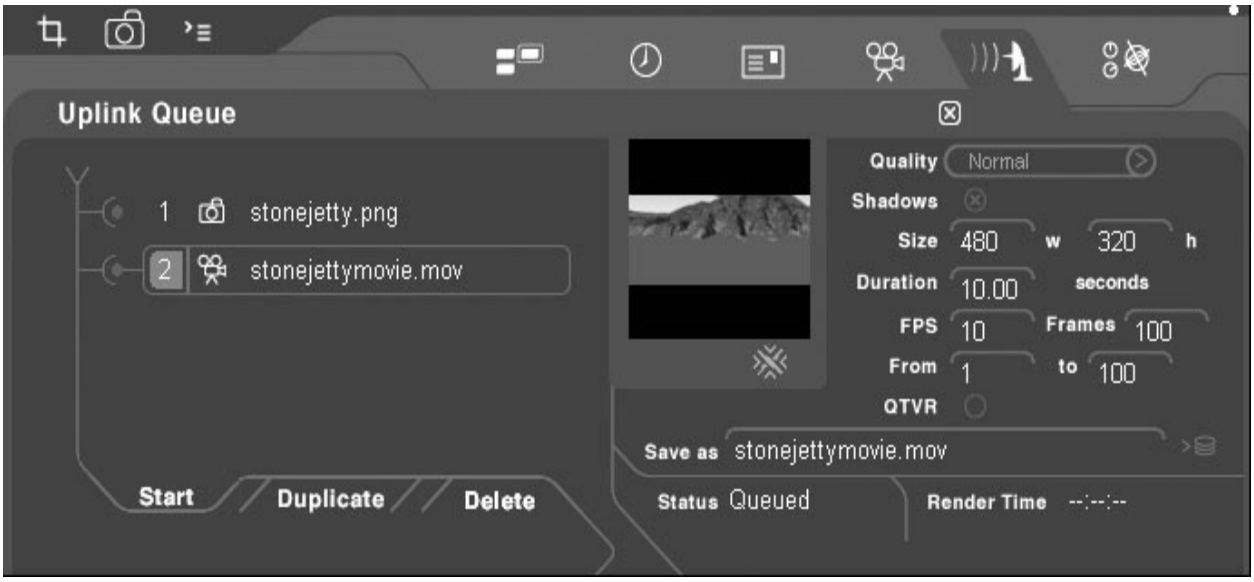
Each log entry stores the date, time, location and the complete state of the planet. This allows the log in a single .mjw file to contain entries from completely different worlds.

Log entries can be given names and descriptions. These are the notes you take on your travels in Parametric Hyperspace — think of it as a National Geographic article you’re writing. A small thumbnail is saved along with each log entry. The icon in the lower left corner of the thumbnail area will be different depending on whether the log entry is a still image or a movie. If it is a still image, the icon is a Jump logo. Clicking this icon will set the RTR scene to match the log entry. If the log entry is a movie, the icon will be a Play button icon. When clicked, the movie plays back in the RTR Window. Additional movie controls are available in the log thumbnail to jump to the beginning or end of the movie as well as a red timeline controller to move forward or backward along the timeline.


Log
3
Orbit 178.32
Rotation 305.39
latitude 45° 48' S
longitude 170° 39' E
Stone Jetty
Fingers of stone reach out into the ocean at the base of this mountain.
New
Delete

Uplink Panel

The Uplink Queue manages render jobs. It allows many renders to be queued up so that they can be processed unattended. We call it the Uplink Queue as a spacecraft metaphor: It always takes time to uplink to a space probe to transmit back to Earth the images it has recorded. Think of the time it takes MojoWorld to render movies and high-quality stills as the time it takes a space probe to transmit such data across deep space to Earth. You can start the Uplink Queue to rendering, go to sleep, and see what it's done in the morning.



Still images are added to the Uplink Queue from the ViewPane Toolbar (ViewPane Toolbar>Render Options Menu>Process Later...). Movies are added to the Uplink Queue from the Movie Panel (Movie Panel>Movie Camera Icon>Process Later...).

The left half of the Uplink Queue Panel shows the batch list. Each list item is made up of four items: the status icon, the batch ID, the camera type and a file name.

The status icons are as follows:
Queued: will be processed when the batch is run.

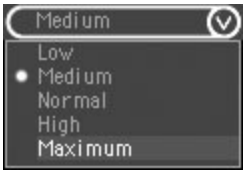
Unqueued: will not be processed when the batch is run.
Completed: already processed, will not be processed again.

The status of a queue item can be toggled between queued and unqueued by clicking on the status icon.
Once a queue item has been completed, the status icon is no longer active.

The batch ID is a sequential number. It is assigned when the Uplink Queue item is created and it cannot be changed. The batch ID is red when the list item is selected.
The camera type icon will show either a still camera or a movie camera depending on whether the queued item is a still image or a movie. This cannot be changed.

The right half of the Uplink Control Panel displays information for the selected batch item.

Quality Setting List Box
Choose from the five render qualities that match those found in the Render Options Menu. Shadows are turned off in the Low and Medium settings, set to Fast Shadows in the Normal and High settings, and set to Full Shadows in the Maximum setting. As the quality of the render increases the images show more detail and the render time increases.



Shadows Checkbox
Sets the shadow mode. This overrides the shadow setting defined by the quality setting defined by the selection in the Quality Settings List Box. Shadows take time to compute, so you can speed up higher quality renderings by turning shadows off. For the Normal and High render settings which normally use Fast Shadows, un-checking the Shadows checkbox will disable Fast

Shadows. For the Maximum render setting which normally uses Full Shadows, un-checking the Shadows checkbox will disable Full Shadows.

Size
You can specify the resolution, in pixels, of the rendered image or movie here. QuickTime VR panoramas will use the smaller of the two numbers to determine resolution.

Duration
Displays the length, in seconds, of a movie previously recorded in the Movie panel. You can speed up or slow down your animation by changing this number.

Frames Per Second
You can modify the number of frames per second in a movie that will be rendered and saved to disk. This will change the number of image files if you save a movie in image files format. It will also affect the rendering time for the movie. The default is 30. Try using a smaller number for rendering quick previews of movies.

Total Frames
This specifies the total number of frames for the entire movie clip. This number is simply the frames per second multiplied by the duration. MojoWorld computes this number, and it cannot be modified directly.

From/To
This specifies a range of frames to render. This can be useful if you want to break up a render job, or render only part of a movie.

QTVR
Instead of rendering a still image of the view in the RTR, the QTVR button allows you to create a Cubic QuickTime Virtual Reality panorama centered on the camera's location. The QTVR button renders six still images and merges them on the faces of a cube centered at the camera's location. This panorama, once

rendered, can be viewed in three dimensions as an immersive environment using the QuickTime 5 player included on the MojoWorld Generator CD. You can rotate the camera around 360 degrees, and zoom in on the image.

To explore such QTVR panoramas, visit www.mojoworld.org or www.pandromeda.com. They give you a sense of “being there” in a MojoWorld, without running MojoWorld.

The Jump button located below the image or movie thumbnail initiates a Hyperspace Jump. The scene in the thumbnail will be displayed in the RTR Window.

Save to Disk icon
Opens a save file dialog to choose a location for the rendered file. The filename before the Save to Disk icon can be modified. This filename can affect the output of the render. If the filename has the extension .mov then it saves the file as a QuickTime movie. If the filename has no extension then the output of the render is saved as a series of still images in the PNG format with numerical names. To modify this format, simply change or append the extension.

The Uplink Queue can save to the following file types for still images: PNG, JPEG, BMP, TGA, and TIFF. Movies can be saved in the QuickTime .mov format, or if one of the still image formats is chosen, a movie will render out as a series of sequentially numbered still images. QTVR panoramas can be saved either as completed QTVR panoramas, by specifying .mov, or as six separate still image files, by specifying PNG, JPEG, BMP, TARGA, or TIFF. When saving a movie or QTVR as a sequence of still images, a third party application will be needed to assemble those images into the final movie.

Status
The Status field shows the status of the Queued item. The status can be toggled between queued and unqueued by clicking on the

status icon portion of the Queue list item in the left portion of the Uplink Queue panel.

Start
To start a batch render, click the Start button. Click the Pause button to temporarily suspend rendering. Click the Stop button to stop the queue completely.
Note: if you stop the queue, you'll lose whatever partial current render is taking place.

Duplicate
To duplicate a queued item, select it then click the Duplicate button. When duplicating a Queue item that has already been processed, the duplicate item will have Queued status.

Delete
To delete a Queue item, select a Queue item to delete then click the Delete button.

A final note about the time of day and adding movies to the Uplink Queue: The time of day used for the movie will be the time of day that is set when the Process Later menu item is used to add the movie to the Uplink Queue. This may produce some surprising results if the movie is not added to the queue immediately after recording. It can also be used to create two nearly identical movies, one where the flight goes through the scene at high noon, and a second where the exact same flight path goes through the same scene with the sun low to the horizon.

Navigation Panel

The tools in this panel are a compass dial, a pitch and roll artificial horizon indicator, an altimeter and the GPS. Any movement in the RTR screen changes the readings on these instruments. Likewise, you can change the settings on the instruments in the panel and the RTR Window will change accordingly.

Artificial Horizon
The Artificial Horizon tool allows you to change camera pitch and roll.

GPS
The GPS displays a rendering of the current MojoWorld and the small circle represents the camera's location on it. You can move this circle to change your location on the MojoWorld and your view in the RTR Window. Right-click on the globe to jump directly to that location. The DDLB associated with the GPS allows you to switch the view of the GPS between a wireframe globe and a rendered globe (with or without shading). The GPS Pause Button pauses the rendering of the GPS globe. This is useful if the MojoWorld is very complicated and the rendering of the globe is slow.

FOV

The FOV calipers control the angle of the field of vision as displayed in the RTR Window. You may change the angle by editing the angle value directly, or by dragging the mouse up or down.

Layout Mode

This mode is the easiest way for new users to jump in and get started in MojoWorld. It purposely restricts most editing and adjustments and provides an intuitive working environment that allows you to create beautiful imagery right out of the box. The mode provides a limited toolset, clearly worded explanations of specific steps and tools, and easy output of the completed image. For advanced 3D professionals, this mode provides a new layout paradigm that can increase productivity — you can open a previously created world and quickly tweak a view to produce a new scene.

In this section, you'll learn:

- How to create a stunning 3D image in five easy steps
- How to add special effects to your image
- How to get a free tool, just for registering your product
- The quickest way to render an image for your needs

Enter & Exit Layout Mode

Most 3D programs require users to learn working environments where they not only manipulate objects along the traditional X and Y planes, but must consider the placement along the Z plane (depth), so a very creative and experienced traditional desktop designer may find the move to 3D a bit daunting. MojoWorld's Layout Mode can provide you with a working mode that is similar to the way you may lay out a picture in familiar 2D programs like Illustrator, Photoshop, CorelDraw, and Freehand.

Layout Mode presents the current view of the planet as a background. You can add objects to the “picture” much like you would add clip art or layers in a 2D application — it is a 2D photographic layout in a 3D program. There are no editors in Layout Mode. Although you can scale or move objects in Layout Mode, you can't change their materials or edit the world while in the mode; this is considered “building” and it should be done in Generator.

Ready to explore? If you're eager to get started, you can jump right in with our Getting Started Tutorial. (The easy-to-use palettes and context-sensitive help will lead you through the creation process.)

Enter & Exit Layout Mode
Layout Mode can be accessed at any time while running MojoWorld by choosing File > Go To Layout Mode. You can easily switch between the various Modes; the tool set and functionality change

completely without changing the planet or your location on the planet.

Tip

You can access Layout Mode with the keyboard shortcut Control-L (Command-L for Mac users).

When you enter Layout Mode, the current RTR view is locked and brought into the new RTR. The RTR in this mode is like the artboard in programs like Illustrator and Draw. Once in Layout Mode, the software remembers the original coordinates from Generator where you entered.

When you exit Layout Mode, you have two choices:

1. Cancel: This option essentially restores your world file to the way it was
   before you entered Layout Mode. The view will be in your original camera
   position. Any objects that were created while you were in Layout Mode
   won't be there, and any objects that were scaled, rotated, or moved while
   you were in Layout Mode will be back in their original positions.

2. OK: When you select this option, the current artboard (RTR) view is passed back to Generator as the current position and camera view. All object changes will be accepted.

There is no method for saving multiple layouts as new views or locations. If you want to save the view you must return to Generator and create a new camera.

Instant Help

To help guide you through the layout process, a series of context-sensitive help screens appears in a fixed palette. Instant Help will always show information specific to the currently active tool palette in Layout Mode and changes on mouse-over for all other tools and icons.

Instant Help is on by default. If you un-check the option, the mouse-overs are deactivated and the fixed descriptions of the palettes remain.

Create an Image in 5 Easy Steps

Once you have entered Layout Mode you're ready to move through a very clear set of activities to create a layout. The activities are grouped under the following tabs found in the lower left portion of the Layout Mode interface:

- **Snapshots**
- **Objects**
- **Lighting**
- **MojoFX**
- **Render**

Snapshots Palette:
Begin by exploring options for a background snapshot. Remember that the JogNav does not appear in this mode. The RTR is locked when you enter Layout Mode; it becomes a “background” for the layout. You can explore alternate locations on the planet using the RandomCam. Each time you click on the six-pip Randomize die icon it triggers the RandomCam to change the view in the RTR. While the camera is doing its random search, it checks for land. When land is found, the random search stops and the RTR displays the new view. If land is not found after 10 tries, the random spot it shows may be in the middle of the ocean. So unless there's more than 10 times as much ocean area than land area on your current planet, most random views will probably contain land!

Layout Mode tracks each location and creates a thumbnail of the RTR (not a render) which it adds to a scrollable log. To add a thumbnail to the log, just click the Save Current View button. You can scroll through the various states and view the RTR thumb-nails; when you click on any thumbnail the Layout Mode artboard (RTR) will switch to that view.

As you create more and more random states, the original snapshot always remains as the first thumbnail (it does not scroll). This allows you to explore while keeping the snapshot you began with. It's as if you took a picture of a field in Canada, then jumped to New Zealand and snapped a picture by a lake, then beamed to Tibet and recorded a view on top of the Himalayas. The original location snapshot is always there to take you back “home” at any time.

It makes sense though, that once you have popped through a variety of potential camera views and seen “the big picture,” you'll want to further explore one of those locations. Once you choose a “place” to create your scene, you can interactively randomize the camera position within the local scene by clicking the two-pip die. The two-pip die will place your camera close to where it is now, but may result in a dramatically different view because you never know what's over the next rise until you go and look. While no view will be exactly duplicated, clicking the two-pip die repeatedly will eventually show you very similar views near the current location.

Zip Render

Another tool to help you choose which snapshots to save is the Zip Render window in the upper left corner of the Layout Mode interface. Often, the Zip Render preview will show you the gist of a snapshot before the RTR fills in completely. The Zip Render options menu in Layout Mode has all of the same options as in

Generator, with the exceptions of the Render Size options Aspect Ratio and Crop. See the Generator section for a complete description of the Zip Render window and its options menu.

See the Objects Palette

Objects Palette

Once you've chosen a snapshot for your background you can begin adding objects to your scene:

3D Model: Click the Teapot icon to open the system file dialog and select any supported 3D file.

Vegetation Object: Click the Leaf icon to open the Plant model library importer.

Boulder: Click the Boulder icon to open the Boulder library importer. Boulders have built-in randomization which allow you to load in a single boulder and then make many Stamp copies where each copy is automatically different from the first. These randomizations are designed by the artist who originally created the boulder object. Some boulder randomizations will be very similar to the initial boulder while others may be strikingly different.

Tip

The Boulder tool and the library of pre-made boulders is added to the app with a separate installer which is downloaded from the Pandromeda website as part of your registration process.

PhotoBillboards: Click the PhotoBillboard icon to open the PhotoBillboard library browser. PhotoBillboards may be any image. If the image has a transparency channel, the PhotoBillboard and its shadow will use this transparency to make the image appear integrated into the world, rather than a simple rectangular “photo” image.

Lightning Billboards: Click the Lightning Billboard icon to open the Lightning Billboard library browser. Lightning Billboards come in two varieties: color and grayscale. Grayscale Lightning Billboards may be colorized in the Object List. The Lightning Billboard icon is simply a shortcut to the folder where lightning-
like billboards have been collected.

Glint Billboards: Click the Glint Billboard icon to open the Glint Billboard library browser. Glint Billboards are just like Lightning Billboards in that they come in color and grayscale varieties, the grayscale ones can be colorized, and the Glint Billboard icon is simply a shortcut to the folder where glint and highlight billboards have been collected.

To the right of the Object Creation icons is the scrolling Object List. Each item on the Object List will have an Eye icon, a Delete icon, and the object's name. Grayscale Lightning and Glint Billboards will also have a color dot between the Eye icon and the Delete icon. Click an object's name to select it. If the Object is visible in the Artboard area and is a 3D Model, Plant Model, Boulder, or a Billboard object, then the object's bounding box will be displayed and the Scale Tool will be made active. Use the Eye icon to toggle the visibility of the object. Use the Delete icon to delete the object.

Note that the Planet and Ocean objects cannot be deleted.

See the Tools section

Tools

The tools in the main Layout Mode interface found to the left of the RTR Artboard are used for manipulating Objects and Lights. These tools are always available to use on Objects and Lights regardless of which tabbed palette is currently displayed.

Pick Tool

This tool lets you select objects by clicking any spot on them. Once an object is selected, you can alter it using any of the transformation tools described below.

Stamp Tool

The Stamp tool is a simple cloning tool. It operates only when an object is selected. When an object is selected and the Stamp tool is made active, a box representing the bounding box of the selected object shows where a stamp-clone will be placed. The Stamp tool places the clones at a fixed distance from the camera.

Scale Tool

The Scale Tool operates on the Bounding Box hot points. These hot points are on each corner and on the center of each face. Dragging on a corner will scale the object uniformly by moving the dragged corner. The opposite corner remains fixed in its current location. If you drag on a corner while holding

down the Shift key, the object is scaled uniformly relative to its center point. If you drag on a corner while holding down the Alt key, the object can be freely scaled. When the Scale Tool passes over a hot point that is on the center of a bounding box face, that entire face highlights yellow. Dragging on the center of a bounding box face scales the object along only one axis by moving the highlighted face. Holding down the Shift key before dragging on a center of a bounding box face will scale the object along only one axis, relative to the object's center.

Translate Tool

When the Translate tool is active, a set of three axes appear at the center of the object. Drag on the box at the end of one of these axes to move the object along that particular axis.

Rotate Tool

When the Rotate tool is active, a set of three rotation circles appear centered on the object's origin hot point. (If the origin hot point has not been moved, it will be in the center of the object.) Drag on a rotation circle to rotate the object in the plane indicated by the rotation circle. Hold down the Shift key to constrain the rotations to 45 degree increments. Hold down the 't' key to bring up a free rotation trackball control centered on the object's origin point.

Drop Button

This causes the selected object to be placed on the land surface.

If the object is floating in the air, it will drop to the ground. If the object is submerged in the ground, it will be raised up so that the lowest point of its bounding box rests on the ground. The keyboard shortcut 'g' (for 'ground') will also place the currently selected object on the land surface.

Stand Button
This causes the selected object's Z axis to be set parallel to local 'up'. No other
changes are made to the object's location or orientation.

You can choose a type of transformation and alter the object using the Manipulate Tool to drag on the Bounding Box hot points or the transform-specific handles. Clicking on an object somewhere other than one of its hot points with one transform tool will cause the next transform tool to be selected. For example, the Scale tool is selected by default when an object is initially selected. Clicking on that object anywhere that is not a scale hot point will cause the Translate tool to be selected. Clicking on the object again on a point other than one of the Translate hot points will cause the Rotate tool to be selected. Repeatedly clicking the object will cycle through the various Transform tools.

Central Transform X

When using any of the Transform Tools, mousing over the object's center will highlight an X at the object's center. This X is a handle with which the object may be moved. Dragging on the central X moves the object in the 2D plane of screen space. Holding the Shift key down and then dragging on the central X will move the object closer to and further away from the camera.

At any time when the central X is highlighted, you can hold down the Alt key then drag on the X to re-locate the object's origin hot point to an offset position. This offset center appears as a target and affects rotations of the object. All rotations take place about this target hot point rather than the object's center. To restore the target hot point to the object's center, hold down the shift key and click on the target hot point.

Undo / Redo Transformation History

Every object maintains a transformation history. When an object is selected, typing Ctrl-z (Cmd-z on the Mac) will step backwards through the object's transformation history to the point where the object was first created. Shift-Ctrl-z (shift-Cmd-z on the Mac) will step forward through the object's transformation history to the point of the most recent transformation.

Views Tool

Switches between the main view and a top view. The top view is centered on the currently selected object, or, if no object is selected, centers on your currently selected camera position. The view is fixed and cannot be zoomed or adjusted.

See the Lighting Palette

Lighting Palette:

Now that the snapshot has been populated with objects, you can use the Lighting palette to create and manipulate lights. Choose from:

Point Light: Click the icon then click on your layout to place the light. You'll see a color dot below the light — click it and the color picker dialog appears so that you can choose the color of the light.

There's also a small white square to the right of the light — drag and watch the white square fade to black. This sets the intensity level of the light. It starts at 100% and can be interactively dragged and adjusted to 0. Note: This is the only way a light's intensity can be changed in Layout Mode!

Spotlight: Spotlights are like point lights, except that the light they cast is directed. The area of light grows with distance like a cone. When the spotlight falls on an object, it forms a circular area of light with two regions: a bright central region and a less bright outer ring that diminishes in brightness the further it extends from the central spot.

Mouse down to place the Spotlight, then before releasing the mouse, drag around to point it — if your mouse passes over an object, that object's bounding box will appear, and releasing the mouse will aim the Spotlight at the object. Use the lock icon to lock the spotlight to the object. The lock icon only appears when the spotlight is
selected and the pick tool is the active tool. When the spotlight is

locked to an object and the rotate tool is active, the rotation circles (or the free rotate trackball which activates when the 't' key is pressed) will appear centered on the point-at object, not on the spotlight itself.

A spotlight has the same color dot and intensity square controls as described for the
point light. These only show when the spotlight is selected and the pick tool is the
active tool. Spotlights also have control handles on the circles which indicate the inner
and outer light cones, so the angle of the spotlight and the sharpness of the light
cone can be adjusted.

FX Spotlight: The FX Spotlight is exactly the same as a regular spotlight, but before it is placed on the artboard, you will be presented with a dialog prompting you for a color gel image and an intensity mask image. If both are left blank, then the FX Spotlight behaves exactly as a plain Spotlight. The color gel colors the light in addition to the color dot control. It's like putting a transparent color image immediately in front of the light source, which may also be tinted by the color dot. The intensity mask provides a grayscale intensity texture in addition to the intensity square control. It's like putting a semi-transparent image immediately in front of the light source in order to create areas of light that may not necessarily be circular. The intensity of the light source is independent of the intensity mask image.

Point lights and spotlights can be removed by clicking the delete “x” next to their names in the Lighting palette.

Time of Day: Drag the dial and watch the sun move around. If any moons are present, they will also move along their orbits when the Time of Day dial is changed.

Time of Year: Drag the dial and watch the orbit line indicators for the Sun orbit and the orbits of any Moons that may be present change their inclinations. This is intended to simulate the change of season. Future versions of MojoWorld will have more accurate celestial mechanics.

See the MojoFX Palette

MojoFX Palette:

MojoFX are a collection of bitmap overlays for weather, lens fl ares, frames, and edges. Some of these effects are in full-color; others are grayscale and can be colorized with a color dot. These effects are post-rendered, so MojoWorld applies the effect over the layout, much like an acetate overlay. You can flip these overlays vertically or horizontally using the fl ip button associated with the effect.

MojoFX are only available in Layout Mode. Once you leave Layout Mode, MojoFX are deleted from the world. You can apply the following MojoFX (each category allows one application only):

Weather: Add an overlay of rain, snow, or fog. Weather effects are grayscale
and can be colorized with the color picker from the object manager. When a
color is applied, the current overlay is tinted accordingly.

Lens Flare: Add a selection of full color or user-defined color lens fl ares that
simulate common camera effects across the full screen. A full-color lens flare
effect cannot be tinted. A grayscale lens fl are will allow selected colorizing.

MojoFX: Add special overlay effects such as static noise, Gaussian noise, or

	scan line effects. A full-color MojoFX overlay cannot be tinted. A grayscale MojoFX overlay can be colorized.
	Frames: Add an artistic edge or frame to the final image. Frames may be full color or grayscale. For grayscale frames, you can select a color for the frame with the color picker.

See the Render Palette

Render Palette

After you've zipped through the Snapshots, Objects, Lighting, and MojoFX palettes, you should have a still image that you want to render. The Quick Render palette provides simplified settings for producing specific sized photos in an efficient rendering time. The preset Quick Render settings are:

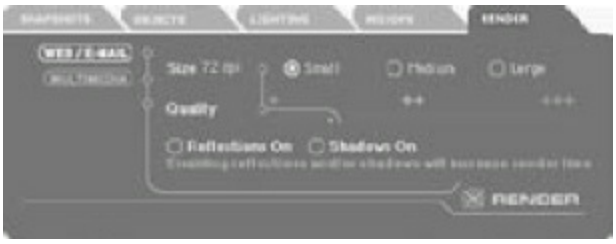
Web/E-mail: This setting creates a 72 dpi render of the fixed RTR. You can choose Small, Medium, or Large.

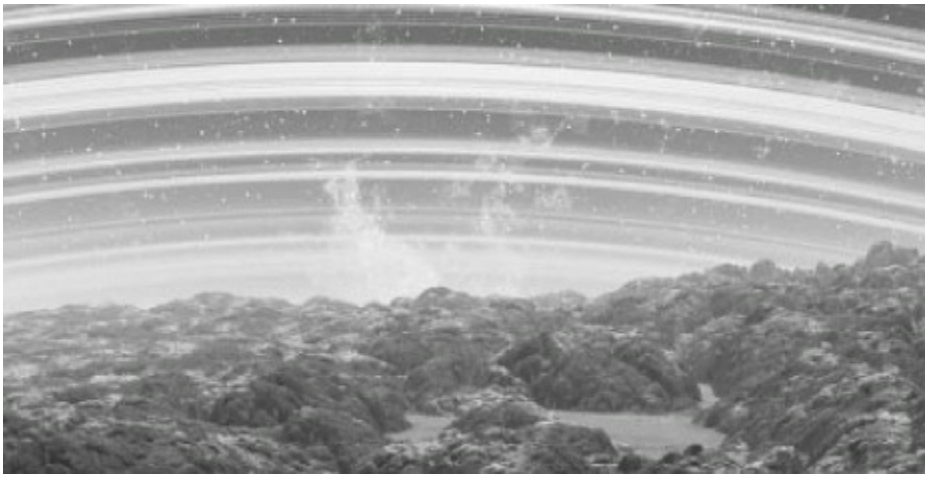
Multimedia: This setting creates larger, 150 dpi renders of the fixed RTR that can be used for most desktop wallpapers and home printing. Options are Sm. Inkjet, Wallpaper, and Lg. Inkjet.

Tip

Use the Quality slider to control both the look of your final image and the render speed. Lower quality renders quickly and gives your image a painterly look, and higher quality renders slow and imparts more detail to the final image.

At the bottom of the dialog box, you'll see options for turning Reflections and Shadows on (they are off by default). Note that enabling reflections and/or shadows will increase render time. Enabling Reflections only has an effect if elements in the world have truly reflective materials. Enabling Reflections is also required in order to render refraction effects for glass-like materials.


RENDER



Introduction to the Planet Wizard

The Planet Wizard and the Library work together to allow you to mix and match elements of many different MojoWorlds into an infinite variety of new MojoWorlds. The Library also contains a great deal of content that is not directly used by the Planet Wizard, so when working in Generator, be sure to explore the various libraries opened with the 'Load From Library' option on each Editor's Options menu.

In this section, you'll learn:

- How to use the Planet Wizard
- Where all presets are kept and the Editors with which they are associated
- How to use the Library Exporter to save your own presets
- How to add your own content to the Planet Wizard

Accessing the Planet Wizard

The Planet Wizard is accessed on the File menu. It can also be be called via a button in Layout Mode. Entering the Planet Wizard will create an entirely new planet, so whatever planet you were previously exploring will be closed, prompting for a save if required. Entering the Planet Wizard from Layout Mode will not clear out any overlays or effects, but will remove all objects. As with any new planet, the Uplink Queue and Log will be empty.

The Planet Wizard is a dialog and must be exited with either the OK or Cancel buttons. The OK button will accept the new Wizard-created planet and will return you to the Interface or Mode from which you invoked the Planet Wizard. The Cancel button takes you right back where you were before you called the Wizard. (It will return you to the previous Interface or

Mode to the state it was in before invoking the Planet Wizard, and will restore the previous planet with all its objects as they were when the Planet Wizard was invoked.)

The two icons at the center top of the Planet Wizard affect all of the elements at once. The six-pip die causes the Wizard to choose a random preset for all eight elements. The clear X causes the Wizard to remove all presets from all eight elements.

The Eight Planet Wizard Elements

These are the pieces from which the Wizard builds a new MojoWorld.

The Land Texture determines the shape of the planet's surface.

The Land Material determines the coloring of the planet's surface and may add
some additional shaping through displacement effects.

The Water element adds an ocean to the planet and determines the ocean's
appearance.

The Sun element chooses from a variety of preset Suns, some of which may have
intense colors of lighting, thus causing the other elements to react very differently than their thumbnails may indicate.

The Moon element adds a single moon. More moons may be added in Generator
later, but the Planet Wizard will only allow for either a single moon or no moon.

The Stars element provides stars and other celestial backdrop features, such
as nebulae.

The Rings element adds planetary rings.

Lastly, the Atmosphere element provides the atmospheric effects and cloud cover
(which may hide the sun, moon, stars, and rings, so it's here in the last slot!).

Each Element's slot is topped with a large Icon type indicator. Next, each Element has its own individual Random / Clear buttons. The six-pip die will choose a random item from the Library associated with that Element. The X will remove any preset specified for that Element.

Tip

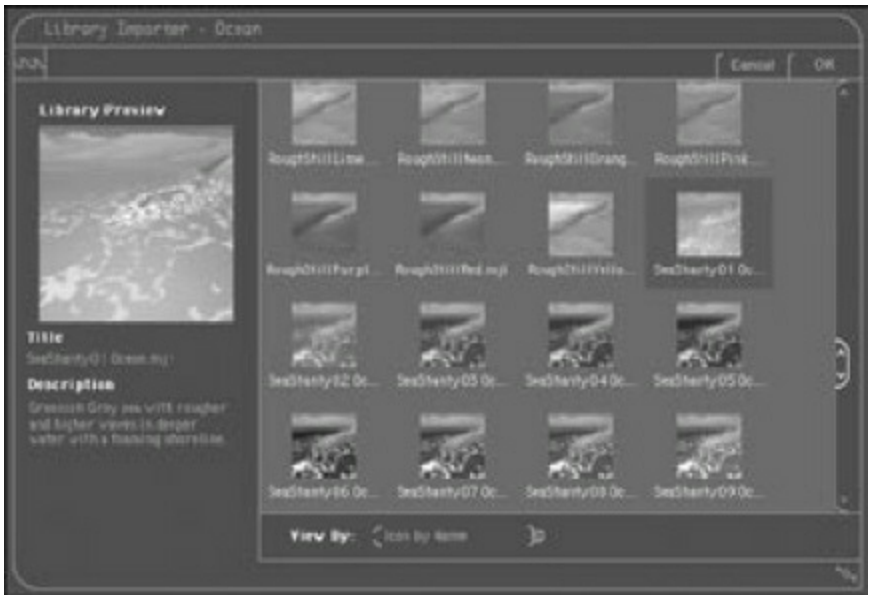
A default Sun and Sunlight source will be included in the new planet even if the Sun Element is left empty.

The lower part of each Element's slot will show a Load From Disk icon if the slot is currently empty, or it will show the thumbnail of the selected preset if the slot is currently assigned. Clicking on the Load From Disk / Thumbnail section of an Element's slot will open the Library Loader dialog to view the Library associated with that Element.

Planet Wizard Library Loader Dialogs

The simplified Library loader shows a subset of the presets located in the folder specific to the associated Element. These folders are kept in the Libraries folder in the MojoWorld application folder. The procedure for adding your own content to the selection that the Planet Wizard uses will be covered after the section on the main Library Exporter dialogs.

Each preset shows as an icon in a scrolling area. Clicking on an icon selects it and shows a larger version of the icon and an optional text description of the preset. When previewing an animated element, this larger version of the icon will be animated. In the upper left are OK and Cancel buttons. The OK button accepts the new Element and closes the Library Loader. The Cancel button closes the Library Loader without changing the Element.



Animated Elements in the Planet Wizard

To the left and below the eight element slots across the top of the Planet Wizard is a checkbox to 'Include Animated.' If this option is selected and the MojoMove add-in is installed, then the Planet Wizard may include animated Elements when building worlds, both in its random selection and in the Library Importer for each element.

Planet Wizard Preview Renderer and Random Views

In the center of the Planet Wizard dialog is a preview renderer. To the left of it is a set of Randomizer buttons for picking random views on the new planet. The first button will have one of three different possible icons: Walk, Fly, or UFO. The selection of icon controls the altitude at which the random locations are generated. When the Walk icon is displayed, the random locations will be at camera altitudes approximating 5 meters, with a random variation of as much as 3 meters. When the Fly icon is displayed, the random locations will be at camera altitudes of 10 kilometers, with a random variation of plus or minus as much as 2 kilometers. When the UFO icon is displayed, the random camera locations will be at camera altitudes of 500 kilometers, pitched down somewhat so as to see the limb of the planet. The dice icons generate random views. The six-pip die will place your camera at random locations anywhere on the lit side of the planet. The two-pip die will place your camera close to your current location, pointed along random headings.

The preview renderer does a multi-pass ray trace rendering of the planet. This creates a quick approximation of the current view, however it does not include material displacement effects. At any time during the ray trace rendering process, the preview renderer can be clicked on to start a REYES rendering of the planet. This will go through the same rendering sequence as a full render: a pre-processing phase followed by the rendering of blocks appearing in columns progressing across the preview. At any time during the REYES rendering process you can click on the preview to cancel the preview REYES rendering. The preview renderer will then return to the ray trace rendering method.

There's no way to preview animated elements in the Planet Wizard preview renderer, so if your world uses animated elements, you'll need to use the MojoMove Editor in the Generator for preview animations.

OK / Cancel Buttons
When you click OK to leave the Planet Wizard, your camera will be in the location you have chosen using the RandomCam preview renderer. If you choose Cancel, you will be returned to your previous interface with the planet you were working on before entering the Planet Wizard. Because entering the Planet Wizard essentially does a File>New behind the scenes, exiting with the Cancel option will re-load the previous planet, so you'll need to wait while MojoWorld does a Hyperspace Jump to restore the previous planet.

The Main MojoWorld Library

All presets including Planet files (.mjw), MojoWorld library preset files (.mjl), and images used for billboards and other effects (.png, .jpg, .tif, etc.) are stored in the Libraries folder in the same folder with the MojoWorld application. It's possible to point MojoWorld to a different location for the Libraries folder by editing the Preferences.txt file, but unless you mirror much of the Libraries folder, specifying an alternate Library directory will break the Planet Wizard.

Library Folder Structure

The Library consists of a hierarchy of folders containing a variety of presets used within MojoWorld. The top level folder is named Libraries. The Libraries folder is in the same folder with the MojoWorld application. The Libraries folder contains many sub-folders for the various MojoWorld Library (.mjl) files, image files (.jpg, .png, .tif, etc.), planet files (.mjw), and one or more Planet Wizard Index (.pwi) files. These sub-folders may contain further nested sub-folders.

The main folder structure of the Libraries folder is as follows:

Boulders

The boulder folder is the boulder holder. This is the default Library home when using the Boulder Tool in the Generator Create palette or in the Layout Mode Objects panel.

CloudLayers

This folder is the default Library home when working with cloud layers in Generator's Sky Editor.

Curves

This folder is the default Library home when working with

both Input Curves and Output Curves when working in Generator Texture Editors.

Gradients
This folder is the default Library home for the Gradient Editor accessed from Gener-ator's Color Texture Editor. Most of the Gradients in this library were extracted from the main library of presets and have generic names starting with 'z'. Most of the gradients have been sorted out into sub-folders.

LandMaterials
This folder is home to the content used in the second element of the Planet Wizard. This is also the Library home when working in Generator's Land Material Editor.

LandTextures
This folder is home to the content used in the first element of the Planet Wizard. This is also the Library home when working in Generator's Land Texture Editor.

Materials
The content stored in this library is designed for use on models and primitives, such as types of wood, marble, glass, mirror, and other various special effect materials. This folder is the Library home for material editors in Generator other than the Land Material Editor and the Water Material Editor.

MojoFX
This folder contains 2d overlay content used in Layout Mode. A sub-folder named FXSpotLight is used for the FX Spotlight tool in both Generator and Layout Mode. The sub-folders named 'Frames,' 'LensFlares,' and 'Weather' are used in Layout Mode's MojoFX panel.

Oceans
This folder is home to the content used in the third element of the Planet Wizard. It's also the Library home when working in both the Water Editor and the Water Material Editor in Generator. Ocean presets may be stored as either an ocean primitive with a material on it, or just as a material. The difference is that loading in an ocean may change the Sea Level, while loading a material onto an Ocean keeps the Sea Level where you have it set. The Ocean presets installed with MojoWorld are all saved as Ocean primitives with a Sea Level of 0. If you save your own Ocean presets, they may be saved with any Sea Level.

PhotoBillboards
This folder contains images with alpha-channel masks or on transparent backgrounds. It is used as the default Library home when using the PhotoBillboard tool in both Generator and Layout Mode. The sub-folders named 'Lightning' and 'Glints' are used in Layout Mode's Objects panel for the Lightning Billboard and Glint Billboard tools, respectively.

Planets
This folder is home to the File>Open with Browser... menu item in the Viewer and Generator Interfaces.

PlantModels
This folder is home to a set of plant models associated with the Leaf icon in the Generator Primitives palette and in the Layout Mode Objects tab.

Primitives
This folder is home to the Load Library Item menu on the Plug-In object. All MojoTree presets are stored in a MojoTree sub-folder of the Primitives folder.

Satellites

This folder is home to both the fifth and seventh elements of the Planet Wizard; the Moon and Rings, respectively. This is the Library home when working in Generator's Moon Editor. Both Moons and Rings are stored in this library.

Skies
This folder is home to the content used in the eighth element of the Planet Wizard. This is also the Library home when working in Generator's Sky Editor.

Starfields
This folder is home to the content used in the sixth element of the Planet Wizard. It is also the Library home when working in Generator's Stars Editor.

Suns
This folder is home to the content used in the fourth element of the Planet Wizard. It is also the Library home when working in Generator's Sun editor.

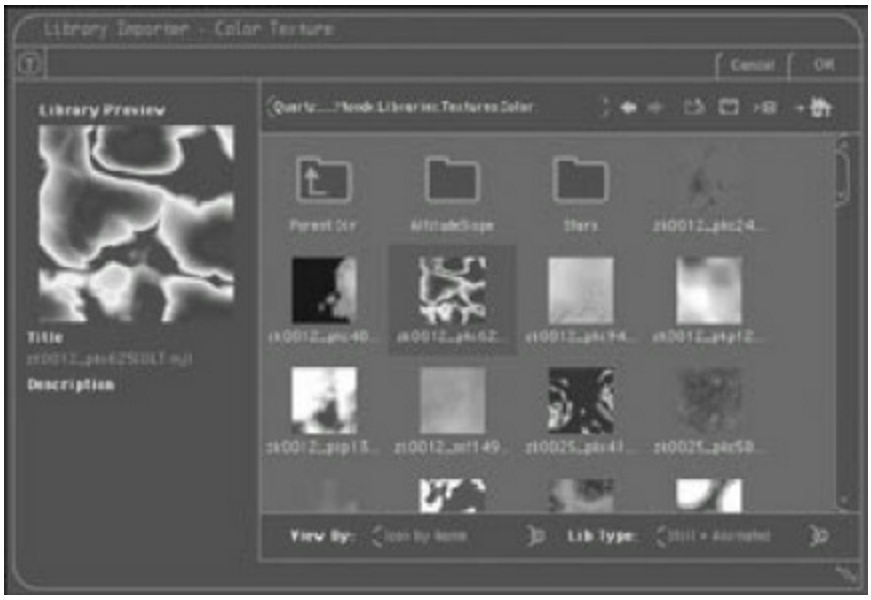
Textures
Textures are broken down into two types: Color and Value. The default installed texture libraries are textures that have been extracted from the main library of presets. All the extracted textures have been given names which relate to the overall sizing of the texture.

A Word About the Preset Texture File Names
The first six characters on the majority of the textures stored under the Textures folder indicate the 'zoom level' altitude of the Texture Editor Preview Swatch. In the Texture Editor, the Preview Swatch default to a 'zoom level' altitude of 100 kilometers. When you click either the + or - key under the Texture Editor Preview Swatch, the 'zoom level' stops at one of several fixed altitudes. These altitudes are used in the file names of the texture presets.

For example, when loading a texture named “zk0025_ pkp1415VALT.mjl” will show a thumbnail in the library loader which will match the thumbnail in the Texture Editor when zoomed to an altitude of 25 kilometers. The 'zoom level' of the Texture Editor preview swatch can dramatically affect the appearance of the texture, so textures loaded in from the library may look very different from the thumbnail shown in the library until the 'zoom level' is made to match the zoom at which the texture was stored. When you save your own Color or Value textures, you are free to use any naming convention you would like.

Library Importer Dialogs

All of the Library Importer dialogs have the same basic structure. A title bar indicates that the dialog is a Library Importer and the type of library object to be imported. An icon appears on the far left which also indicates the type of library object this specific Library Importer dialog will access. On the far right are the OK and Cancel buttons. No other part of the MojoWorld interface is active while a Library Importer dialog is open. Click OK to accept your choice or Cancel to close the Importer without making changes.



The column on the left will show a larger version of the thumbnail associated with the selected preset. It will also list the selected preset's name and description, if present.

A toolbar between the top section of the dialog and the area which displays the contents of the current folder is used to navigate available folders. A path field shows the full path of the currently viewed folder. Two small arrows pointing left and right move backwards and forwards through the folders you've visited since invoking the Library Importer. The Select Folder icon opens an

Operating System-specific dialog which allows you to navigate to network drives. The Go To Desktop icon will display the contents of your Desktop in the Library Browser. The Load From Disk icon allows you to bypass the thumbnails and directory browsing to get an Operating System-specific File dialog to select a specific file to load. The Home icon is only shown when the folder being browsed is one other than the default home Library folder for the type of preset being imported. The Home folder associations are listed in the previous section.

The large central area shows a Parent Dir folder icon with an up arrow on it. Double-clicking this icon will cause the Library Importer to display the contents of the parent folder. Any folders nested within the currently viewed folder will show as folder icons listed before any preset files. Double-clicking a folder icon will cause the Library Importer to display the contents of that sub-folder. When the Library Importer dialog is in the main Libraries folder, the sub-folders that are home to the Planet Wizard libraries have extra icons on them showing that association.

Below the icons area is the View By DDLB, which allows you to view by Icon or by Name, with an optional Date sort. A second DDLB which allows you to specify whether the presets shown should be still and animated, or still only, or animated only. For Generator users who do not have MojoMove installed, selecting an option other than 'Still' will bring up a dialog about the MojoMove add-in.

Library Exporter Dialogs

All of the Library Exporter dialogs have the same basic structure. Across the top is a title saying that the dialog is a Library Exporter followed by the name of the type of item is being exported. Below is a header that has an icon on the left indicating the type of item being exported, and on the right are the Cancel and OK buttons.

The left side of the dialog is where you may configure what preview thumbnail is used for the preset.

The right side of the main dialog is where you may specify the file name and a text description. The File Name field is followed by a Save to Disk icon, and if you are not currently in the Home Library folder, the Home icon will be present. The default text for the description says, “Enter Description Here ...” If that is left alone, the text description which will be displayed after saving will say, “No Description.” If you blank out the text, then the text description will be empty. If you type new text, your new text will be shown when this preset is selected in a Library Importer.

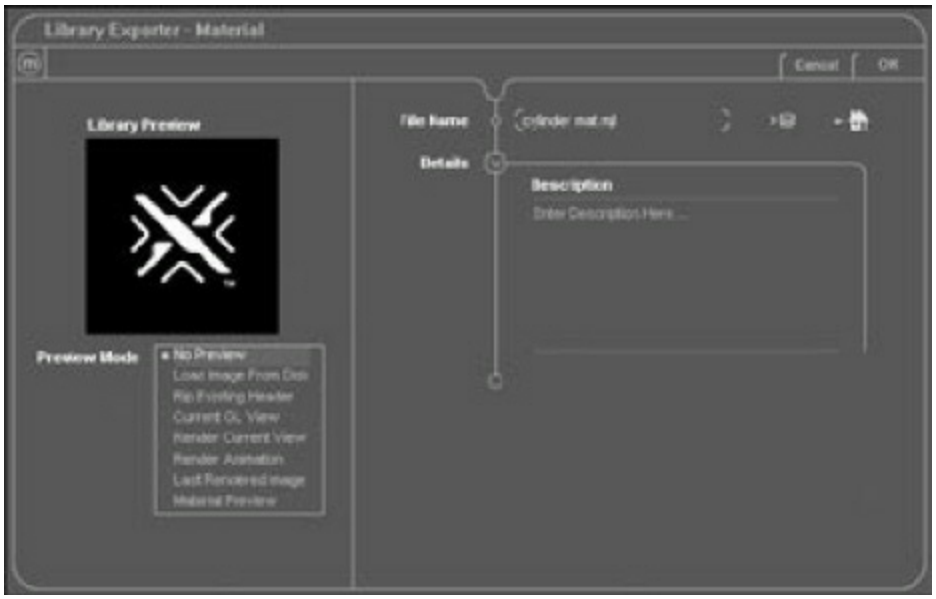
Library Exporter Thumbnails

Most of the Library Exporter dialogs have similar options for the Preview thumbnail. Some of the Exporters have options that are specific to the item being exported. Preview Mode options that are available in all Library Exporters are:

No Preview
This uses a generic Jump Logo as the preview icon.

Load Image From Disk
Selecting this option will cause a Filename field to appear below the preview thumbnail area. Click on the Load from Disk icon which appears at the end of this filename field to open an Operating System-specific dialog with which to select the desired image.

Rip Existing Header
Selecting this option will cause a Filename field to appear below the preview thumbnail area. Click on the Load from Disk icon which appears at the end of this filename field to



open an Operating System-specific dialog with which to select the desired .mjl file. Any existing thumbnail as well as any descriptive text will be extracted from the selected .mjl file and put into the current Exporter dialog for further editing and saving.

Last Rendered Image
This option will use the image from the last completed render.

Many of the Library Exporters also include the following options for the Preview Mode. These options are found in all Exporters except for the Curve and Gradient exporters:

Current GL View
This option grabs the current RTR display to use for the preview thumbnail.

Render Current View
Selecting this option causes a small set of rendering options to appear below the Preview Mode options. The first is a Setting DDLB which lists all the available render settings, including user-defined ones. Next is a checkbox labeled 'Fit to Box.' When 'Fit to Box' is off, the render will be at the aspect ratio of either the RTR for the preset render settings, or as specified by the user-defined

render setting. Selecting 'Fit to Box' will ignore any aspect ratio information of the render setting and will render the full square icon. Next to the 'Fit to Box' checkbox is a camera icon. Clicking this starts the render at the specified quality and aspect ratio. While the render is in progress, the camera icon changes to a stop icon. Click the stop icon at any time to abort the preview render. Render status messages will be displayed below while the render is in progress.

Render Animation

You must have MojoMove installed to use this option. Selecting this option causes a small set of rendering options to appear below the Preview Mode options. The first is a Setting DDLB which lists all the available render settings, including user-defined ones. The next item is a Start Time parameter. See the MojoMove section for how the Start Time affects animated elements. Below the Start Time is a Duration parameter. This specifies how many seconds of animation should be rendered. After this is a DDLB to select the frame rate. Since this is a thumbnail preview, the default frame rate is 10 FPS. The frame rate may be adjusted to as low as 1 FPS or as high as 30 FPS. This Preview Mode also includes the 'Fit to Box' option. When 'Fit to Box' is off, the render will be at the aspect ratio of either the RTR for the preset render settings, or as specified by the user-defined render setting. Selecting 'Fit to Box' will ignore any aspect ratio information of the render setting and will render the full square icon.

Next to the 'Fit to Box' checkbox is a set of icons for rendering and playback. First is a Play icon, which if there is currently no animated header, will be dimmed. Next is a still camera icon, which starts rendering the individual frames at the specified quality and aspect ratio. While the render is in progress, the still camera icon changes to
a stop icon. Click the stop icon at any time to abort the preview render. The Movie Camera icon at the far right will prevent any camera motion that may be attached to the current camera. If the

current camera has been used to record an interactive flight path, it will move during the preview animation unless the Movie Camera icon has an
X through it. If the current camera is under the control of a KH_Avion or KH_Mover object, it will move regardless of the status of the Movie Camera icon. Render status messages will be displayed below while the render is in progress, including information on which frame is currently being rendered.

Tip

If you use 'Rip Existing Header' to bring in an animated preview, you must first switch to 'Render Animation' for the entire animation to be saved in the new header. If you do not first switch to the different Preview Mode of 'Render Animation' and leave it on 'Rip Existing Header' when the item is saved, the preview will lose the information that it is an animation and will save only the first frame.

A few Library Exporters have options that are specific to the item being exported:

Material Preview
This is available on every Material Editor except for the Material Editor associated with the Ocean. When selected, additional controls appear below the Preview Mode selector which allow you to sample the planet, switch to a three dimensional view, zoom in or out, and an altitude readout. More information about the Material Preview options are covered in the Generator section section on the Material Editor Preview Swatches.

Tip

The Material Editor for the Ocean does not have a Material

Preview option because the Material Preview does not correctly interpret the parameters of the Water Material. It's recommended that you save a render of the water material over a plain gray terrain in order to accentuate the Water Material parameters.

Texture Preview
This is available on all Texture Editors, including the Land Texture Editor. When selected, additional controls appear below the Preview Mode selector which allow you to sample the planet, switch to a three dimensional view, zoom in or out, and an altitude readout. More information about the Texture Preview options are covered in the Generator section on the Texture Editor Preview Swatches.

Curve View
This option is only available in the Curve Editor. The thumbnail created is a miniature version of the curve editing area.

Gradient View
This option is only available in the Gradient Editor. The thumbnail created is a square version of the gradient.

Adding Content to the Planet Wizard

For content to show up in the Planet Wizard, it must fit specific criteria. First, it must be kept in the proper folder. Next, it must have a thumbnail. The Planet Wizard will ignore any presets that do not have thumbnails, even if they meet the last criterion, which is that the preset must be listed in a Planet Wizard Index file.

Planet Wizard Index File Format
There is an empty User .pwi file included in the Libraries folder. This is a text file with comments at the top describing the format. To add your own content to the Planet Wizard, each preset you wish to add must be listed in a Planet Wizard Index File. By keeping all of your content listed in your own User.pwi file, you can easily make it visible to or hide it from the Planet Wizard by moving this file into or out of the Libraries folder.

The format of an entry in the Planet Wizard Index File is as follows:

Type
This string indicates which of the eight Element types for which this preset is used. The acceptable values are:

terrain
material
ocean
sun
moon
stars
ring
sky

MojoMove Flag
This field must say either 'false' or 'true' to indicate whether it is an Animated preset.

File Name
The file name field must be enclosed in double-quotes. It must also include the .mjl extension.

An example of an entry in the .pwi file looks like this:

moon false “SimpleMoon01.mjl”

The Planet Wizard reads all .pwi files in the Libraries folder. Generator comes with a Standard.pwi file. The MojoMove package will install a MojoMove.pwi file. Additional content packages will install additional .pwi files for the content suited to the Planet Wizard.

A Last Warning
The content used in the Planet Wizard is a carefully selected subset of presets which are designed to work reasonably well together. In particular, inappropriate pairings of Land Textures and Land Materials can result in some unpleasant render artifacts. Use caution when adding your own content to the Planet Wizard!

Introduction to Generator

The Generator Interface is where you get to create your very own MojoWorlds. You can build complete planets to your exact specifications — Generator provides control over every detail through a complete editor set.

This section includes information on:

- The Generator Interface and its tools
- Editor windows — how they work and how to work with them
- The Texture Editor and the Material Editor
- Tutorials to reinforce knowledge of the Texture and Material Editors
- The rendering process and its related Editors (the Movie Editor, the Uplink
  Queue, the Preferences Editor, and the Render Room)

How to Get to the Generator Interface

The program launches into the Generator Interface. If you've switched to the Viewer UI or the Render Room, return to Generator by choosing “Go to Generator…” from the File menu (Menu Bar>File>Go To Generator). If you quit the program, the next time you open MojoWorld it will automatically launch into Generator.

Overview of the Generator Interface

The Menu Bar

File

New

This selection creates a new MojoWorld consisting of a flat gray planet with no land texture assigned to it. It has an Earthlike atmosphere, a sun control, a sun light source, an ambient light source, and a default gray land material.

New with Planet Wizard... This selection creates a new MojoWorld from pieces in the Library files. See the Planet Wizard / Library section for details.

Open...
Allows you to open .mjw files with a system-specific file dialog.

Open Using Browser...
This option opens the Planet Library Browser. See the Planet Wizard and Library section for details on working with the Library Browser.

Save...
Save changes to your current MojoWorld (.mjw) file via a system-specific file dialog. Log entries, Hyperspace Mixer settings, and Uplink Queue entries are saved in this file. Rendered images are not saved with this command. If the world file has never been saved before, a Library Exporter dialog will open with which you may optionally add a thumbnail preview and text description of your planet. See the Library section for the specifics of working with the Library Exporter dialog.

Save As...
The same as above, but allows you to select a new MojoWorld (.mjw) filename, a new preview thumbnail, and a new description. Refer to the Library section for specifics of working with the Library Exporter dialog.

Revert to last save
This option reloads the current file from disk. This is useful if you are not satisfied with changes made to the MojoWorld since the last save to disk.

Import Terrain...
Launches the Import Wizard which will walk you through the process of importing heightfield data into a Parameter Bomb,

along with an optional texture map.

Export Terrain...
Launches the Export Wizard which will walk you through the process of exporting either the entire planet or the area within a Parameter Bomb.

Export QTVR...
Launches the Export QTVR Wizard which will walk you through the process of exporting a Cubic QTVR Panorama with the option of having clickable Hot Spots
enabled.

Info...
Opens a dialog box containing the software version information.

Tip

Critical tech support information regarding your video card and video drivers,and your serial number will be found in this box! The information from this dialog is required when contacting Pandromeda support.

Planet Info...
This option opens a dialog box that allows you to save comments and author information to the MojoWorld file. Type new information into the blank fields provided then click "Commit Comment" to add the new information to that which is already displayed in the Author Information Window. New information is
appended to current comments, and does not replace old information.

Go to Viewer
Opens the Viewer Interface. The same MojoWorld file remains

open and the RTR Window in the Viewer Interface displays the same view as was displayed in the Generator, though with a different window size and shape. Any stowed Generator editors will be put away. Any stowed image windows will remain in memory and will be present when you return to the Generator. If you have any stowed image windows, you will be warned before going to the Viewer interface so that these images may be saved.

Go to Render Room
Opens the Render Room. You may start all queued entries from here. See the Rendering section in this section for a complete description. Any stowed image windows will remain in memory and will be present when you return to the Generator.

Go to Layout Mode
Opens the Layout Mode interface. See the Layout Mode section for a complete description. Any stowed image windows will remain in memory and will be present when you return to the Generator.

Exit / Quit
Quits the program. If you have performed any action other than moving around the planet you will be prompted to save your MojoWorld (.mjw) file. If you have stowed image windows, an extra prompt allows you to save them all, discard them all or cancel out of exiting the program.

Generator Editors

Editors
Hyperspace Mixer
The Hyperspace Mixer in Generator works the same as the Hyperspace Mixer in the Viewer, with the addition of a numeric readout showing each slider's position as a value between 0 and 1.

Slider

A slider selects a single numerical value within a specified range. The numerical value can be entered directly by highlighting the value with the mouse and then entering the new value with the keyboard. If the value specified falls outside of the slider's range, the value will be restricted to the minimum or maximum value of the slider.

Log
Opens the Log Editor. The Generator Log Editor is equivalent to the Log Editor in the Viewer Interface. Log entries are shared between Viewer and Generator Interfaces.

Movie
Opens the Movie Editor. The Movie Editor allows you to create movies that record the camera path in Walk, Fly, and UFO modes. The Movie Editor is explained in detail in the Editors section of this section.

Navigation
Opens the Navigation Editor. The Navigation Editor looks and performs like the Navigation Panel in the Viewer Interface. You may change the Pitch and Roll by dragging the small white circles in the Horizon indicator, or you can directly edit the values. You may also change the camera location on the MojoWorld by dragging on the small green circle on the GPS indicator, or by simply right-clicking the globe to go directly to a location. Latitude and Longitude may also be edited directly in the Navigation Editor. The Dropdown List Box, or

DDLB (pronounced “deedle-bee”) associated with the GPS allows you to switch the view of the GPS between a wireframe globe or a rendered globe (without shading, with shading, or fully rendered). The GPS Pause Button pauses the rendering of the GPS globe.
This is useful if the MojoWorld is very complicated and the rendering of the globe is slow.

Uplink Queue
This option opens the Uplink Queue dialog where you manage your queued render jobs. The Uplink Queue Editor is explained in detail in the Rendering section of this section.

Preferences Editor

The options in the Preferences Editor allow you to configure behaviors in MojoWorld.

Enable ToolTips
ToolTips are the helper labels which display the function of a button or tool when you pass the mouse over its label. When this option is checked, the Delay (millisecs) thumb wheel appears. This controls how long the mouse must remain over the tool before the ToolTip appears.

Enable Tempfile
If a Tempfile is specified, MojoWorld will save a copy of your work in progress before every render and whenever you are prompted to save but choose, “no.” A Tempfile can help you recover your work in the event of an unplanned system failure. When this option is checked, the Tempfile Name field appears. The Temp-file is always stored in the same folder with the MojoWorld application.

Randomizer Mode
This allows you to specify how the MojoWorld Texture and Material randomizers are to work. 'Fast and Simple' will give you fast and non-complicated textures. Slow and Complex' will generally give you much better looking textures but which could render a lot slower.

Randomizer Scale
This sets the 'scale' or 'size' of the textures that the randomizer will produce. The value corresponds to the approximate Largest Feature values used by the various random fractals.

Control Stack Precision
This slider controls the number of decimal places of accuracy of

the various sliders and thumb wheels that appear in the MojoWorld Editor Control Stacks.

Generator UI Mode
The Generator Interface has two Operating Modes: Simple and Normal. The Simple Generator Mode limits the number of parameters shown on the Control Stacks in many of the editors.

Force Functionable
Available only in MojoWorld Pro. Several parameters in various editors throughout MojoWorld cannot be driven with a texture or a function. However, in order to create Hyperspace Mixer Sliders or to animate those parameters using the MojoMove suite of Pro UI nodes, you must be able to attach a function. The Force Functionable preference enables the 'semi-square' widget on these parameters, which allows arbitrary Function Graphs to be attached.

RTR Mouse Mode
This DDLB controls how the RTR responds to mouse drags. The default mode is 'Flight Sim' where dragging downward in the RTR moves the view upwards, to simulate flight control. The option 'First Person Shooter' reverses that motion, causing the RTR to mimic many popular first-person games. The 'Camera Drag' option causes the view to move as if the mouse actually grabs the land and can be compared to the hand tool in many other graphics programs.

Camera Pivot Point
This DDLB controls how the RTR behaves when an object is dragged with the Pick Tool and the right mouse button. Right-drag in the RTR with the Pick Tool will spin the camera around the point where the mouse-down occurred on the terrain. If that mouse-down for the right-drag happens to be on an object, the center of the camera's spin is defined by this DDLB. The default option 'Object Center' causes the camera spin to be centered on the center of the object. The option 'Intersection Point' refers to the actual point on the surface of the

object where the mouse-down for the spin motion occurs. The option 'Object Hotpoint' will be the same as the Object Center unless the object's hot point has been relocated.

See the section on the Transform tools for more information about relocating an object's hot point.

RTR Cloud Detail
This thumb wheel controls the resolution of the clouds in the RTR for when the Textured With Clouds preview style is used. Larger numbers result in higher fidelity clouds but slower RTR performance.

Bounding Box Options
This Control Stack expands to show additional preferences for the Bounding Box behavior.

Bounding Box Mode
This will only be of interest to users who have extensively worked with objects in earlier versions of MojoWorld. The option 'Default' uses the new style object bounding boxes. The option 'Classic' uses the central object control axes from version 2 and earlier. No bounding box is displayed for objects when this option is selected. The option 'Classic (with bbox)' uses the central object control axes, but also shows the extent of the bounding box.

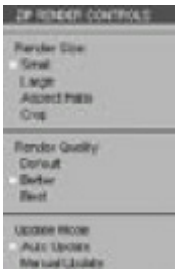
BoundBox Color
This color dot allows you to specify the color for the primary object space bounding box. The secondary alternate space bounding box is always shown in orange. See the section on the Transform tools for more information.

Hotpoint SnapToGrid
When this option is checked, relocating an object's hot point will snap to the closest corner or bounding box face center point when the hot point is dragged close to one of those other control points.

Preview Renderer

Preview Renderer
At the top left corner of the Generator interface is the Zip Preview Renderer (pictured below). This small preview uses a highly optimized ray tracing renderer which is progressive and is active unless the Preview Renderer has been put in Manual Update mode. The ray tracing renderer does not see material displacements. When the mouse cursor is over the Preview Renderer, it will highlight in green indicating it is ready to switch to its alternate renderer. Click the Preview Renderer to begin a REYES Render of the preview. The REYES Renderer does see material displacements. A status readout underneath the Preview Renderer will show the active stage of the render. A yellow square indicator shows which block is currently being processed. At any time while the REYES Render is in progress, the Preview Renderer will highlight red with a mouse-over. Clicking on this red highlight will stop the REYES Render and return to the ray trace renderer. During the REYES Render of the Preview, the entire Generator UI is frozen until the REYES Render completes or is stopped.

Preview Renderer Options Menu
The Preview Renderer Options Menu is accessed via the Menu icon under the lower right corner of the Preview Renderer. Note that this menu icon is not visible when a REYES Render is in progress and the area is being used for render status readout.



Menu Icon This icon opens a small pop-up menu of options. The options differ depending on the context of the Menu icon.

Render Size
Choices for Render Size are Small, Large, Aspect Ratio, and Crop. Small is the default, Large uses the same fixed aspect ratio as Small. The Aspect Ratio setting uses the same aspect ratio as the currently selected render setting. The Crop setting uses the same aspect ratio as the Crop Window. If the Crop Window is not
on, the Preview Renderer defaults to Large.

Render Quality
Choices for Render Quality are Default, Better and Best. The Render Quality setting affects both the ray trace renderer and the REYES Render. In addition to including progressively more detail. Shadows are never present in the Preview Renderer.

Update Mode
The default is Auto Update which starts a new ray trace render each time there is a change to the camera's position or the parameters of the world. Manual Update stops this automatic ray trace render and only updates using a REYES Render when clicked.

Top Toolbar

The Top Toolbar runs horizontally across the top of the RTR Window. This toolbar is broken up into four main groups of tools. These are the RTR Utility Tools, the Render Utility Tools, the Camera Control Tools, and the Online Tools. Each of these sections of the Top Toolbar are covered below.

See RTR Utility Tools

See Render Utility Tools

See Camera Control Tools

See Online Tools

RTR Utility Tools

The RTR Utility tools are used for choosing your locomotion mode, selecting an RTR preview style, and for pausing and restarting the RTR window.

Pick Tool
The Pick Tool can be used with the right mouse button as a navigation mode in the RTR.
With the Pick Tool selected, dragging on the planet with the right mouse button (Mac
users, hold down the Control key while dragging) pans the camera around the point of
the initial mouse-down on the planet's surface. Holding the shift key down while drag-
ging on the planet with the right mouse button will zoom the camera in or out from
the initial mouse-down point on the planet's surface. The Pick Tool also allows you to
select imported objects and primitives. Details of interacting with objects in the RTR are
covered in the Transform Tools section of this chapter.

Walk mode
Allows leisurely exploration of MojoWorlds via keyboard controls. The camera stays
at a constant height above the terrain. See the section on Walk mode in the Viewer
chapter of this manual for a detailed description.

Fly mode
Allows free camera motion that simulates fl ying an airplane. The mouse controls most
of the navigation. In level fl ight, your path follows the curvature of

the planet. See the
section on Fly mode in the Viewer chapter of this manual for a complete description.

UFO mode
UFO mode is similar to Fly mode, except the camera does not follow the curvature
of the planet in level fl ight, and velocity is proportional to altitude. UFO mode is for
making animated zooms in and out from MojoWorlds.

Preview Dropdown List Box
This Dropdown List Box changes the display in the RTR Window between three differ-
ent preview styles. The default is Textured, which applies simple textures to the land.
The Textured with Clouds option also indicates clouds in the sky. Use the wireframe
mode when you want to record smooth animations of MojoWorlds so complex that
they slow the RTR down.

Dropdown List Box
A Dropdown List Box, or DDLB (pronounced “deedle-bee”), presents a list
in which only one item may be active at a time. Clicking on a list item selects
it and closes the list. There are two styles of DDLBs: One has a small bracket
and down-pointing arrow to the left of the selected item. The other has a
larger circle with an arrow in it, to the right of the selected item.

Pause *Pause Button*

If you click on the Pause button, the RTR Window freezes. All camera motion stops, and the view stops rendering in real-time. This option allows you to free up CPU time if you want to switch between applications. When the RTR Window is paused, an icon appears in the top left corner of the RTR window and the window darkens while paused. To restart the RTR Window, simply click on the Jump button immediately to the right of the Pause button.

Jump Button
The Jump button restarts the RTR Window after it has been paused. The Jump logo is white when the RTR is active.

Render Utility Tools

The Render Utility tools are used for cropping an area of the RTR to render, starting a new render, and for selecting your render settings.

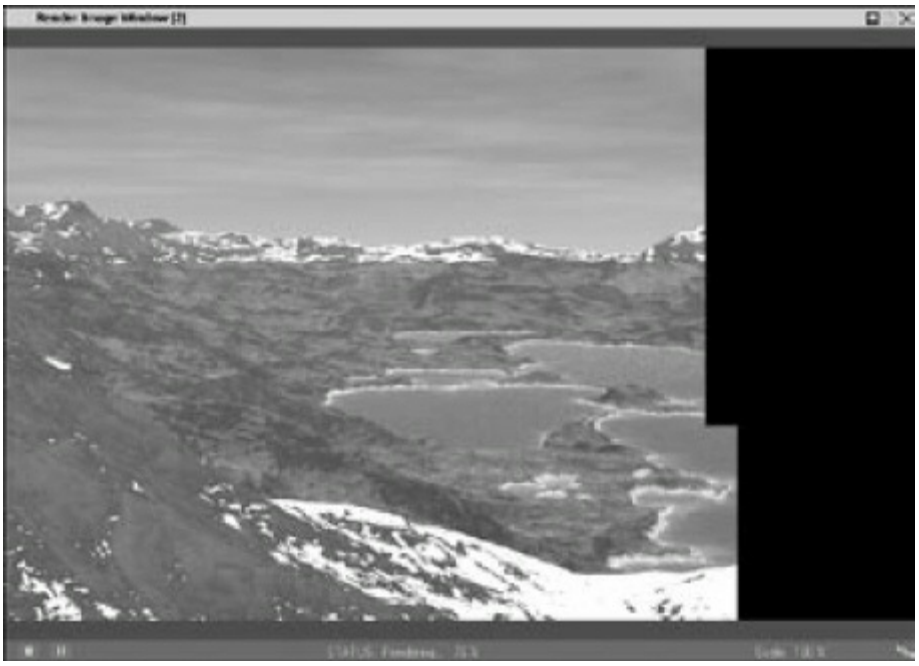
Crop Window
This button opens the Crop Window used to render a detail in the RTR Window. The Crop Window appears in the RTR Window as a slightly brighter transparent window entitled “Crop.” You can position this window anywhere in the RTR Window using the gray Crop label centered on the top edge. You can resize the window by using the resizing boxes in the top left and lower right corners. Once the Crop Window is positioned, you can click on the Camera icon to render only the part of the scene displayed in the Crop Window. In the lower left corner of the Crop Window is the Crop Zoom Tool. Click the Magnifying Glass to change your camera's FOV and orientation such that the area within the crop window zooms to cover the entire RTR area (aspect ratios permitting). Once zoomed in, the Magnifying Glass remains red and clicking it a second time reverts to the non-zoomed state. If any changes are made (moving the camera, editing the planet, etc.) while in the zoomed-in state, it is no longer possible to undo the zoom. The Camera's location on the planet's surface does not change, only its Field of View.

Camera
The Camera button opens the Render Window and launches a Photorealistic Rendering at the render quality selected in the Render Options Menu. (The default quality setting is Medium.) You should select your options in the Render Options before beginning a rendering. For a definition of “rendering” and an introduction to the rendering process see the Camera section of the Viewer section. See the Rendering section of this chapter for a detailed discussion of rendering and render options.

See The Render Window

The Render Window

The Render Window displays the progress of a Photorealistic Rendering of the scene in the RTR Window. When the render completes or is stopped by clicking the Stop button, the Render Window becomes an Image Window. The tools available at the bottom of these two types of windows are different.



Render Window

The Render Window has a toolbar along the bottom containing the following tools:

Stop
Ends the current rendering and remains open in its partially completed state. You
can return to Generator and perform any actions within it. However, you cannot
resume the rendering once stopped. To complete the rendering you must exit the

Render Window and restart it. The partially completed rendering can be saved
to disk as-is.

Pause
Temporarily stops the current rendering. The icon turns red when the rendering is
paused. To restart the rendering re-click on the Pause icon.

Status
The Status indicator reports the render's progress.

Scale
The Scale indicator shows whether the Render Window is showing the image at
full size or smaller. If the full image size is larger than can be displayed, the render
will take place at 50% or smaller, depending on how small the image must be
made to fit entirely within the Render Window.

See the Image Window

The Image Window

When the render in a Render Window completes or is stopped, the Render Window
becomes an Image Window, as seen here.

The toolbar along the bottom of an Image Window includes the following tools:

Pan Icon
Allows you to pan around the image in the Image Window. This is particularly
useful if the image is larger than the size of the window.

+ - Zoom
The + and - buttons allow you to zoom in and out of the image in the Image
Window.

Scale
The Scale indicator on the Image Window indicates the zoom level that has been selected using the + - Zoom tool.

Save to File
Opens a Save dialog box for saving the image in the Image Window. The default format is PNG; other options include BMP, JPEG, TGA and TIFF.

Save to File
The Save to File icon opens an operating system dependent file finder dialog.
An appropriate extension will be added to the filename as determined from
context of the current editor.

Resize Window
The Image Window can be resized by dragging the lower right corner.

Render Settings Menu

Render Settings Menu
At the top section of this menu are options that refer to the current view or to Image Windows. The second section consists of the single option for opening the Render Settings Editor. The third section contains a listing of the pre-defined render quality settings. The Render Quality Setting options include Low, Medium, Normal, High, and Maximum. By default the render setting is Medium. Select the setting before you begin a rendering. Remember — as the quality of the rendering increases the image shows more detail, but the time it takes to render also increases. A fourth section will appear when you've defined your own custom render settings. A white dot will appear next to the currently selected render setting. Only one render setting from the combined third and fourth sections of the menu may be selected at one time.

Options in the first section of the menu are:

Add to Log…
This selection opens the Log Editor and creates a new log entry for the current
view. See the Log Editor section of this chapter for more information.

Process Later…
This selection opens the Uplink Queue Window and creates a new Uplink Queue
entry for the current view. See the Rendering section of this chapter for more
information.

Last Rendered Image...
This option reopens the Render Window with the last completely rendered
image. Once you render another image, the last image is lost and becomes this
new one, unless you had saved it to disk.

Open Image off Disk...
Opens a dialog box that allows you to open an image saved on disk into an
Image Window.

Render QTVR…
Renders a simple Cubic QTVR of the current location without Hot Spots. To enable
Hot Spots in your Cubic QTVR Panoramas, you must either use the File->Export
QTVR option or you must queue the render job and enable Hot Spots in the Render
Queue. See the Rendering section of this chapter for more information.

The second section of the menu is:

Settings…
This selection opens the Render Settings Editor. In this window you may define and
edit custom render settings. Details of the Render Settings Editor follow below.
The third section of the menu lists the pre-defined render quality settings. See the
table found after the Render Settings Editor section for the specific values and set-
tings used for the pre-defined render quality settings.

The third section of the menu lists the pre-defined render quality

settings.

Render Settings Editor
When you initially open the Render Settings window it is empty except for the toolbar
at the top. To create your own custom settings you must first create a New Setting or
clone an existing setting. The five preset settings cannot be edited.

Render Settings Editor Options Menu

Add New Setting
This option creates a new render setting with default parameters. The default
name is “New Entry”.

Delete Current Setting
This option deletes the currently selected setting. If there are remaining custom settings defined, another will become selected. If there are no more custom settings, the editor will be empty.

Clone Current Setting
This option makes a copy of the currently selected setting and appends the word “Copy” to the name.

Render Settings Editor Control Stack
Once an editable render setting is selected, the parameters defining that render setting are shown on the Control Stack.

Control Stacks
The Parameter Area of each editor contains a Control Stack. While Control Stacks take different forms, their basic functioning is the same. Control Stacks display each Parameter of the object being edited. Next to each Parameter appears either a Controller or a List Box. When a Controller is present the Parameter's value can be manipulated with the controller, or it may be changed directly by highlighting the text with the mouse and typing in a

new value.

Render quality is primarily dependent upon two parameters: Antialiasing and Geometry Size.

Antialiasing
This slider may be set to an integer value from 1 to 6. The integer refers to the number of samples the rendering takes inside each pixel. The default value is 1, which is equivalent to no antialiasing. The number of samples MojoWorld takes per pixel is the square of this integer, so for a value of 2, 4 samples are taken, and for a value of 5, 25 samples are taken. Larger values result in slower rendering times but higher quality
images.

Geometry Detail
This slider controls a real-valued number between 0.0 and 10.0. This number represents how finely the terrain is diced. Low numbers give large polygons and low detail, higher numbers give smaller polygons and more detail. The greater the Geometry Detail number, the more detailed the rendering. There is little need for values greater than 5.

Shadows
The Shadows DDLB lists three options. “None” means that no shadows will be rendered. The “Full Shadows” option renders shadows as determined by the individual shadows settings configured in the Object List and in the various Cloud Layers. The option “Fast Shadows” is the same as “Full Shadows” with the exception that the “Cast Shadows” setting for the Planet object and any Satellite objects (planetary rings and moons) will be assumed as OFF. With this “Fast Shadows” setting, the Planet object and Satellite objects will not ever cast shadows regardless of their shadows setting, but all other objects will obey their cast / receive shadows settings in the Object List.

Enable Reflections
This checkbox enables all ray tracing functionality for the render setting. The Enable Reflections option will not activate reflective

and/or refractive properties of materials unless those materials already have these options configured in the Ray Tracing properties. See the Materials Reference for more information on the Ray Tracing parameters of materials.

Width and Height
These dimensions specify the size of the rendering in pixels. If the Aspect Ratio DDLB below the Width and Height parameters is set to 'Free', then the two values are entered independently. If the Aspect Ratio DDLB is set to any other choice, then changing the Width will proportionally change the Height and vice-versa.

Aspect Ratio
This DDLB lists the aspect ratios of many common formats. When set to 'Free', the Width and Height values can be changed independently. For all other settings, changing either the Width or the Height will also change the other dimension according to the chosen proportion.

Advanced Settings Control Stack
The Advanced Settings are on a separate Control Stack. Click the Control Stack Expand widget to display the additional parameters.

Bucket Size and Sub-Prim Threshold
During a rendering the image is diced up into bucket sized chunks. The geometry is then chopped up into similar sized parts and a list of these parts is stored in each bucket. The Bucket Size thumb wheel controls the size of the buckets, and the Sub-Prim Threshold thumb wheel controls the size of the geometry. A Sub-Prim Threshold of 1.0 means that the geometry is the same size as a bucket. A Sub-Prim Threshold of 2.0 means that the geometry is twice the size of the bucket.

Memory use during rendering is dependent on the number of buckets and the number of sub-prims in each bucket. Larger bucket sizes work better for larger images. Larger Sub-Prim Threshold values can also keep memory use down.

Once the bucket size has been established and the geometry divided, in each bucket the primitives are diced into polygons and rendered into the bucket image. An additional factor regarding memory use at this point is that if a particular sub-primitive appears in more than one bucket, its polygons remain in memory until all the buckets that use it are completed. This is what uses the most memory during a render. Setting a smaller Sub-Prim Threshold can keep this type of memory use down because the smaller primitives will appear in fewer buckets, and need to keep their geometry around for less time. The defaults are sensible for most scenes, and changing these may result in high memory usage.

Redo Buckets
This allows the Renderer to detect when it has missed something, and makes it revisit the effected bucket in a second rendering pass. The Redo Buckets option uses very little memory, since it only keeps a list of the buckets that need to be revisited. All the primitives in those buckets are redone from scratch during that redo pass, so there is no polygon grid memory carried over from the first pass
to the redo.

The system of memory usage during the render cycle is very complex, but it can be summed up as follows:
Bigger buckets reduce initial memory usage, but can increase rendering memory usage. Small Sub-Prim Threshold values can increase initial memory usage, but decrease rendering memory usage. You should leave these values at their default settings unless you really want to fine-tune the rendering process, because often finding a balance between these two values produces counter-intuitive results. Be prepared for a certain amount of trial and error. However, these issues become less important with the tiling options, as an image can be broken into arbitrarily small chunks that will render in the available memory.

Tile Size
Setting a Tile Size causes the Renderer to chop an image into blocks and render each block separately. The Tile Size is the resolution of

the block in pixels (it is a square tile). Tile rendering is only applied in the Render Room. The tiling parameters are ignored in the Generator Interface.

Border Size
The Border Size is the amount in pixels by which the tiles overlap. This is to prevent visual artifacts from appearing at the tile edges. 10 pixels should be sufficient for most images.

Start Tile / End Tile
Tiles are numbered from left to right, then top to bottom. The range of tiles is in integers from 0 to a number equal to the number of tiles. By declaring the start and end tiles you may control what part of an image is rendered. A value of -1 for a Start Tile represents the first tile and a value of -1 for the End Tile represents the last tile.

Click OK to accept your changes and close the Render Settings Menu. Select Cancel to close the Render Settings Menu without your changes. Remember that tiled render settings only apply in the Render Room. For the pre-defined tiled render setting, you will most likely want to leave the Start Tile and End Tile both set to -1 and in the event you need to render only a partial range of tiles, the Start Tile and End Tile parameters should be changed in the Uplink Queue editor.

Camera Control Tools

The Camera Control tools are used to select a camera and to open the camera edit dialog.

Camera Selection Dropdown List Box
The first option on this DDLB after the currently selected camera is an option to 'Clone Current'. Choosing this option will make a copy of the currently selected camera with a two digit sequential number appended to the camera's name. The new cloned camera becomes the active camera. All currently defined cameras are listed in the lower section of the DDLB. Selecting a camera from this list switches to that camera.

Edit
The Edit button opens the Camera Editor.

Camera Editor
The Camera Editor displays the settings for the current camera and allows you to edit and rename cameras with different fields of view and locations.

Camera Selection Dropdown List Box
This DDLB displays the available cameras. When you change cameras, the name of the camera and its field of view appear in the Camera Editor window. If the Jump button is selected, the RTR Window will Jump to the location of the camera you selected. If the pause is selected, then click on the Jump button to initiate a Hyperspace Jump in the RTR Window.

Camera Editor Options Menu
The two options in this menu are Add New Camera and Delete Camera.

Add New Camera
This option adds a new camera with the same Field of View and location as the
currently selected camera. The new camera's name is the same as the currently
selected camera's name with a two digit number appended, or if the camera's
name already ends in a number, the number will be incremented.

Delete Camera
This option deletes the currently selected camera. If there is only one camera left
in the world, you will not be allowed to delete it as the world file must always
have at least one camera present.

Pause

Pause and Jump
The Pause and Jump buttons affect whether the RTR Window is updated as each parameter within an editor is changed. If the Jump button is active (the default), changes made to parameters in the editor may show up in the RTR Window when the parameter value is changed. It is important to note that not all changes are visible in the RTR Window. For example, because ocean waves are not previewed in the RTR Window, changes to the ocean material will not be seen until a rendering is performed.

Turning Pause mode on in any Editor turns it on for all Editors. When working on a complex MojoWorld, pausing while you make changes can speed up working dramatically by eliminating the delay inherent in repeated Hyperspace Jumps. After making the desired changes, click

the Jump icon to see the changes in the RTR Window. This activates Jump mode for all Editors; Jump mode will remain active until it is paused again.

Name
Enter a unique name for your new camera to distinguish it from others you may have in the Camera Selection DDLB.

Camera FOV
Use the calipers to change the selected camera's field of view in the horizontal plane. You can specify angles between 0.0 and 180.0 degrees.

Calipers

Calipers specify angles between 0.0 and 180.0, inclusive. Drag up or down on the calipers widget to decrease or increase the angle. Cali-pers are used for a camera's field of view and the angle of spotlights.

Online Utility Tools

The Online tools are used for connecting to the MojoWorld online community.

Connect to mojoworld.org
This icon opens your default web browser and connects to the mojoworld.org
website.

MojoWorld Online
This icon launches the MojoVox Chat Utility. See the MojoVox section for more
information.

Global Parameters

Global Parameter Tools
The Global Parameters Tools are found just to the outside of the left edge of the RTR window, near the top.Global Parameter tools affect the whole MojoWorld.

Time Editor
The Time Editor dialog has two radial controls that perform the same functions as the Time of Day and Season Indicators in the Viewer Interface. The first radial control rotates the planet on its axis. (It may be simpler to think of this as the sun and moon rotating around the planet, but later versions of MojoWorld will have solar systems where the correct interpretation is important.) This rotation specifi es the time of day. The second radial control alters the time of year in the planet's orbit around the sun. (This will also become more important in later versions of MojoWorld.)

Tip

Turn the pause button off before using the time controls, so that you can see
the changes in the RTR Window as soon as the controls are released.

The paths of the sun and moon(s) are displayed in the RTR Window as lines in the sky
(moons have blue lines, the sun has a red line).

Radial Control

Radial controls specify angles between 0.0 and 360.0. Drag the arm around either clockwise or counter-clockwise to decrease or

increase the angular value. For finer control, the mouse can be dragged further away from the control, or hold down the Shift key and the control will be much slower. Radial control values can also be entered directly from the keyboard.

Global Parameters Icon

This icon forces the Hot Buttons area to display the Global Parameters Hot Buttons. Upon opening MojoWorld, the Global Parameters Hot Buttons are displayed, but as soon as you start working with objects, alternate sets of Hot Buttons will be shown in the Hot Button panel instead. Descriptions of the Global Parameters Hot Buttons follow below.

Object List Icon

Opens the Object List. The Object List is a dialog box that lists all selectable objects. Objects are listed alphabetically by name with the object type beside it. When de-selected, the Eyeball icon hides the object it controls. The Cast and Receive check areas refer to shadows. If the cast area is checked for an object then that object casts shadows for renders with shadows enabled. If the receive area is checked, then the
object may have shadows cast on it by other objects, including clouds for renders with shadows enabled.

Tip

If 'Fast Shadows' are used, the Planet object and any Satellite objects will not cast shadows regardless of the Cast Shadows checkbox setting.

Eyeball
The Eyeball icon indicates whether an object is visible or hidden. If an Eyeball is displayed, the object is visible (if the current view contains the object). If an Eyeball is not displayed, the object is hidden regardless of the current view.

The Scroll Tab on the left of the window moves your view up and down the list if the list is longer than can fit in the view.

Scroll Tabs
A Scroll Tab is a tab that is attached to a vertical line. The Tab may have a small arrow on either end to indicate if there are more items above or below. Drag on the Tab to scroll the list. Some scroll bars are resizable. This is indicated by a small gap in the vertical line just above the bottom end. Drag up or down on the gap to expand or contract the visible area of the list. Scroll bars may be found on the right or on the left. If an Eyeball icon is grayed out, the object is hidden regardless of the current view.

A set of three tools is found at the bottom of the Object List dialog.

Delete Item
Some items cannot be deleted, such as the Ambient Light, the Sun Light,
and the Planet object. Other items, such as the Ocean, must be deleted
through its associated editor.

Duplicate Button

Creates copy of the currently selected object. Note that some things such
as the planet, sun and ocean can't be duplicated. The newly created object
appears in exactly the same position as the old one.

Find Object
For imported objects and primitives placed on the planet's surface, this icon
will cause the camera to jump to that object looking straight down at it from
above. The Find Object icon will not find a primitive or imported object that
is used as the render object for a Moon or the Sun.

MojoMove
The MojoMove icon opens the MojoMove Editor. See the section on the MojoMove
Editor later in this section for more information.

Global Parameters Hot Buttons

Hot Buttons Display Area
This area displays the Hot Buttons associated with the currently selected object. Use the Global Parameters Icon above to force the Hot Buttons area to display the Global Parameters Hot Buttons.

Global Parameters Hot Buttons
From top to bottom, the Global Parameters Hot Buttons are: Stars Editor, Sun Editor, Moon Editor, and the Sky Editor. A gap separates the Hot Buttons here. The lower group of Hot Buttons continues with the Water Editor, Water Material Editor, Land Editor, Land Texture Editor, and the Land Material Editor.

Stars Editor

The Stars Editor allows you to set the parameters of the Star Backdrop. For best
results, the color texture applied to the backdrop should be mostly black. Bright or
light colored Star Backdrops can make moons look oddly wrong.

Sun Editor

This selection opens the Sun Editor. In the current version of MojoWorld you may have
only one sun. (Later versions of MojoWorld will allow multiple suns.) The parameters
of this sun are controlled in the Sun Editor. See the Sun Editor section of this section
for details.

Moon Editor

This selection opens the Moon Editor. You may define as many moons as you like.
Using the Moon Editor you can add moons, edit their parameters,

and define their
orbits. The Moon Editor is also where Planetary Rings are defined and edited. See the
Moon Editor section of this chapter for details.

Sky Editor

The Sky Editor allows you to set the parameters of the atmosphere and cloud layers. You
can add and delete cloud layers. See the Sky Editor section of this chapter for details.

Water Editor

The Water Editor lets you create and control the sea level of a planetary ocean. The Material Editor hot button associated with the Water Editor allows you to control the parameters of the ocean such as color, transparency and the displacement texture that creates waves on the ocean. See the Water Editor section later in this chapter for details.

Material Editor (Circle-M)
Opens the Material Editor. Multiple Material Editors can be open at one time.

Land Editor

The Land Editor controls the terrain of your MojoWorld. You can set the radius of your MojoWorld, and in the associated Texture and Material editors you can control aspects of the MojoWorld's terrain like shape and color. See the Land, Texture and Material Editors sections for details.

Texture Editor (Circle-T)
Opens the Texture Editor. Like the Material Editor, multiple Texture Editors
can be open at one time.

Main Generator Tool Palette

Create Palette
The Create palette contains tools for selecting and modifying specific areas of the MojoWorld, tools for creating various primitives, and tools for creating light sources.

Parameter Bombs

Parameter Bombs™ are the way you get local control of the mountains, clouds, water, and textures in MojoWorld planets. Specialized Parameter Bombs create River Terrain Continents and forests of procedural trees which may be confined to the area of the forest bomb, or may affect the entire globe.

The Parameter Bomb Palette contains four tools: the Square Marquee, the Circle Marquee, the River Terrain, and the MojoTree Forest tool. For the two Marquee tools and the River Terrain tool, select the tool and then drag in the RTR to define the affected area. Once the Parameter Bomb is created, the Hot Buttons area will display a stack very similar to the Global Parameters Hot Buttons, with the addition of a Parameter Bomb Editor icon at the top of the stack. The MojoTree Forest behaves somewhat differently. Refer to the MojoTree section for more

information.

Inside the volume enclosed by the marquee you can change the same parameters that appear in the Global Parameters Menu, but their region of influence is limited to the area inside the marquee. (Before you try Parameter Bombs you should learn about the various Editors in the Generator Interface.)

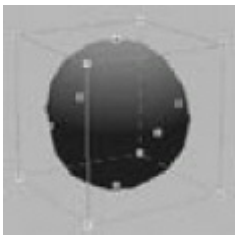
Square Marquee
The Square Marquee selects a pyramid-shaped volume of the MojoWorld. The apex of the pyramid is at the opposite point of the planet and the base extends beyond the planet's surface into the sky. The Square Marquee is used to define Parameter Bombs that can affect the terrain, water, and the sky within the pyramidal volume.

Circle Marquee
The Circle Marquee selects a cone-shaped volume of the MojoWorld where the apex of the cone is at the opposite point of the planet and the base extends into the sky. The Circle Marquee is used to define Parameter Bombs that can affect the terrain, water, and the clouds within the conical volume.

River Terrain
The River Terrain tool selects a pyramid-shaped volume of the MojoWorld and defines a river network on a specialized terrain. See the River Terrain section for more information.

MojoTree
The MojoTree tool creates a forest primitive on the surface of the MojoWorld. See the MojoTree section for more information.

Primitives



A primitive is a three-dimensional object that can be rendered. Generator provides you with nine basic primitives:
Sphere, Box, Cylinder, Cone, Torus, N-Pyramid, Rectangle, Circle, and Terrain Patch.
Additional tools appear in the Primitives palette which have some specialized behaviors and these will be discussed in detail below. The specialized primitives are: Marker Flag, Plant Model, Boulder, PhotoBillboard, and Imported Model.

After selecting a primitive tool on the Primitives palette, drag in the RTR Window to interactively size the primitive. The precise resizing behavior of the primitive as you place it depends on the type of primitive. After a primitive has been placed, you can select it by clicking on it in the RTR with the Pick Tool, or by clicking its entry in the Object List. Selected primitives are identified by a bounding box and by the readouts in the Object Properties area. Working with the Bounding Box is covered in the Transform Tools section. The details of the Object Properties display area are found in the Bottom Toolbar section.

> When a primitive is selected two hot buttons appear in the Hot Button Bar. The top hot button displays the icon of the primitive selected and opens the Primitive Editor. The Circle-M hot button opens the Material Editor for the material associated with the selected primitive. Using the Material Editor you can change the way the surfaces of your primitives look by setting parameters for things like color and shininess. The Material Editor is described in reference to the Land Editor.

Primitive Editor
The Primitive Editor enables you to name an object you have created and change its size. Since each primitive has a different shape, the Control Stack of each is described in the following sections. Tools in the Primitive Editor that are the same for all primitive types are:

Primitive Selection Dropdown List Box
The DDLB in the top left corner of the Primitive Editor selects which primitive has its Control Stack displayed in the Primitive Editor window. The Primitive Editor opens with the Control Stack for the currently selected primitive. You can choose another primitive for editing by selecting it from this list.

Primitive Editor Options Menu
The three options in this menu are Clone, Delete and Save to Library.

Clone
This creates an identical copy of the primitive, slightly offset from the original. The copy's name is the name of the original but with a two-digit sequential number appended. This copy can be renamed and manipulated just like any other primitive. The material applied to the primitive is also cloned, so editing the material on one copy does not affect the material applied to the other copy.

Delete
This selection deletes the primitive currently selected in the Primitive Selection Dropdown List Box.

Save to Library
Allows you to save the parameters and material of a primitive to a Library. You can re-use primitives saved to the Library with the Load Library Item selection in the Imported Object menu described in the Imported Object section below. Libraries can also be shared with other MojoWorld users

Transform Data
Most primitives also have a Transform Data Control Stack Expander at the bottom of their respective Control Stacks. The Transform Data Control Stack allows some, but not all of the Transform Data to be edited directly. Not all of the Transform Data listed below will be available for all primitives.

World Size
The World Size indicates how large the primitive is in the X, Y, and Z dimensions of World Space. The World Size can be edited, but doing so changes only the apparent size of the primitive in the world.

Object Size
The Object Size cannot be edited. To change the size of a primitive, one must edit the various parameters of the primitive, for example, the sphere primitive's Radius parameter.

Object->World Scale
These three values represent the factor by which the Object Size is multiplied in order to result in the World Size. These values can be edited, but doing so only changes the apparent size of the primitive in the world.

Lock Proportions
This checkbox is on by default. With the proportions locked, changing a primitive's X dimension will proportionally change its

Y and Z dimensions at the same time such that the primitive maintains its original proportions. With this box unchecked, a change to one dimension will scale the primitive only along that dimension.

Rotation
The Rotation fields display the primitive's rotation in relation to World Space. The Rotation values are read-only. See the Rotation Tool in the Transform Palette for information on how to rotate primitives.

Latitude
This value represents the Latitude location of the center point of the primitive. The Latitude may be edited directly, but be warned that doing so may cause the primitive to go flying out of your current view and you'll probably need to use the Find Object tool in the Object List to find it again.

Longitude
This value represents the Longitude location of the center point of the primitive. The Longitude may be edited directly, but be warned that doing so may cause the primitive to go flying out of your current view and you'll probably need to use the Find Object tool in the Object List to find it again.

Altitude
The Altitude value represents the distance between the center point of the primitive and the current terrain. The Altitude may be edited directly. It is far less likely that you'll lose your object by editing its Altitude versus editing the Latitude
or Longitude.

Hot Spot URL
The Hot Spot URL control stack allows you to define interactive elements for when the planet file is being explored

with the Viewer interface, or for Hot Spots in QTVR output.

Enable Hot Spot
This checkbox enables or disables the Hot Spot associated with the primitive.

URL
This field may be the full URL of a website or it may be the name of another QTVR Movie file.

Target
This option allows you to specify whether clicking the Hot Spot should open a new browser window or if it should continue to use the current browser window.

Title
The text from this field will be shown in the Viewer RTR window or in a panel of the QTVR Player.

See List of Primitives

Primitives

Sphere

Creates a sphere. The single parameter available in the Primitive Editor is the radius. The radius may be changed using the Sphere Radius thumb wheel. After a sphere has been deformed, this radius may have little to do with the actual size of the spheroid, however it will still act to scale the spheroid. For example, if a sphere has been deformed from an original base radius of 10 to a spheroid whose x, y, and z sizes are 5, 10 and 20, changing the base radius parameter to 20 would double the size of the distorted spheroid. The Radius parameter defines the Object Position input coordinates for any textures applied to the Sphere.

Thumb Wheel

A Thumb Wheel is used to specify a single numerical value. Dragging left on the Thumb Wheel decreases the value; dragging right increases the value. The numeric value may also be highlighted and specific value entered with the keyboard. For parameters that are restricted in range, the Thumb Wheel will not go above the maximum or below the minimum values.

Box

Creates a box. Boxes have length, height, and width parameters that can be modified in the Primitive Editor.

Cylinder

Creates a cylinder. Cylinders have a height and radius that can be modified in the Primitive Editor. The End Cap parameter specifies whether the ends of the cylinder are hollow or sealed. If the checkbox is checked, the cylinder is sealed.

Cone
Creates a cone. Cones have a height and a radius that can be modified in the Primitive Editor. The End Cap parameter specifies whether the base of the cone is sealed or open. If the checkbox is checked, the cone is sealed.

Torus Creates a Torus (donut shape). A Torus is defined by two radii: the Torus Radius, which is the distance from the center of the torus to the center of the pipe, and the Pipe Radius, which is the distance from the center of the pipe to the pipe surface.

N-Pyramid
Creates a pyramid whose base has n sides. The number of sides is defined in the Primitive Editor, where n can be an integer value of 3 or larger. Values of n larger than 10 produce pyramids that begin to look like cones. The End Cap parameter specifies whether the base of the N-Pyramid is sealed or open. If the checkbox is checked, the N-Pyramid is sealed.

Rectangle
Creates a two-dimensional rectangle. The height and width can be set in the Primitive Editor.

Circle
Creates a two-dimensional circle. The radius can be set in the Primitive Editor.

Terrain Patch
A Terrain Patch is a square that you can place in the RTR Window. You can assign such terrain patches an altitude and a Texture or Material independent of the planet surface. In the Primitive Editor for the terrain patch, you can name such patches and alter the dimensions of the patch, depth and width. You can also assign it a height texture that can be manipulated in the

Texture Editor. Terrain Patches cannot be exported. For exporting terrain sections, see the Parameter Bomb Marquee tools.

Marker Flag

Creates a Marker Flag. A Marker flag may be placed in the RTR Window. A Marker Flag is not a render object, so it may not be given a material or texture. It can be given a color and a size.

Marker Flag Editor

In the Marker Flag Editor you can specify the name of a Marker Flag, and change its color and height. You can also see the altitude of the Marker Flag in the Marker Flag Editor.

Plant Model

The Plant Model Icon is a leaf. Clicking this icon opens the Plant Model Library Importer. The Plant Models in this library are pre-textured meshes.

Boulder

The Boulder Icon opens the Boulder Library Importer. A boulder is a special kind of primitive. While it has been possible since Version 1 to make boulders out of “displaced spheres,” those were subject to bad render artifacts and did not scale well. The boulder primitive is more robust with respect to render artifacts and is designed explicitly to scale well. The Boulder tool is an add-in you will receive as a special Thank You for when you register your MojoWorld product at the Pandromeda website.

PhotoBillboard

The PhotoBillboard Icon opens a MojoWorld Library Importer

dialog displaying thumbnails of the PhotoBillboards Library folder. Most any 2D image can be used as a PhotoBillboard. See the Library section for more information on PhotoBillboards.

Imported Model

The Imported Model Icon is shaped like a teapot. It opens an Operating System-specific File dialog prompting for a 3D Model. Formats accepted by MojoWorld include 3DS, OBJ, LWO, and DXF. These imported models can be manipulated in MojoWorld just like MojoWorld primitives.

Plug-In Object
This icon opens a menu that allows you to load a library item. Various object plug-ins may also appear on this menu.

> *Load Library Item…*
> Loads a previously saved library item from disk. The item must have been previously saved from a MojoWorld Primitive Editor. Once loaded, you can place this item in the RTR Window.

Lights and Light Editor

Lights
Allows you to create additional light sources on your planet, other than the sun and ambient light. The types are Radial, Spotlight, and FX Spotlight. Choosing the FX Spotlight tool will open a dialog prompting for a Color Gel and a Intensity Mask before it will allow you to place the light. Choosing the Radial or Spotlight tools will immediately be ready to place a new light in the RTR. Use a simple click to place a Radial light. To place a Spotlight or FX Spotlight, the initial mouse-down determines the location of the spotlight. Before letting go of the mouse, drag to indicate which direction the spotlight should point. While dragging just after spotlight creation, any objects that are in the path of the spotlight will highlight as the mouse passes over them. If the mouse is released while an object is highlighted, the spotlight will be set to point at that object.

> Once placed, a hot button appears in the Hot Button Bar that allows you to open the Light Editor and change the parameters for the currently selected light source.

Light Editor (for Ambient Light)
To access the Ambient Light editor, double-click the Ambient Light object in the Object List. The Ambient Light object cannot be deleted and an Ambient Light is created with all new planets. Ambient Light has no spatial or directional characteristics. It is constant for all surfaces regardless of orientation. However, Ambient Light is dependent on atmospheric conditions and reduces in intensity with distance from the planet surface. You may modify the Color, Falloff by Height, and Nightside Ambient properties of the MojoWorld Ambient Light.

Color
Sets the color of the ambient light.

Color Dot

The Color Dot widget opens the Color Picker dialog and allows you to select a single color for a color parameter. The Color Picker is described in the Editors section of this chapter.

Falloff by Height
The height at which the Ambient Light falls off to half intensity. If your moons are looking strange, one possibility is that they are coming within range of the Ambient Light. This parameter is hidden in Simple mode. See the section on the Preferences Editor for more information about the Generator UI Mode preference.

Nightside Ambient
A value which ranges between 0 and 1 and affects the visibility of the dark side of the planet when viewed from space. For the classic 'crescent planet' shot, set Nightside Ambient to 0. This parameter is hidden in Simple mode. See the section on the Preferences Editor for more information about the Generator UI Mode
preference.

Light Editor (for a Radial Source) Creates a Radial light source that emits light in all directions. In the Light Editor the parameters that may be modified are:

Name
You can edit the name of your light for identification purposes.

Color
Sets the color of the light source. The color can also be set

interactively in the RTR via a color dot shown underneath the light object's RTR representation.

Intensity
Controls the intensity of the light radiating from the light source. Total light is equal to the color multiplied by the intensity. The intensity can also be set interactively in the RTR via a greyscale chit shown next to the light object's RTR representation. Setting the intensity in this way only allows for a range of 0 to 1. The intensity can be set to a value outside of that range within the light editor.

Falloff
This checkbox indicates whether the light from the source will fall off with distance or continue infinitely.

Falloff Distance
If the Falloff box is checked, the Falloff Distance thumb wheel controls the distance from the source that the light is at half intensity. The Falloff Distance is represented in the RTR by a simple wireframe.

Remake GL Preview
Since a light has no actual size, the GL Preview is of an arbitrary size. If you've moved your camera away from your light source, it may now be too small to see. Clicking the Remake GL Preview punch-button will cause the light object to redraw itself at an appropriate screen size for the current camera view.

Shadows
The Shadows Control Stack has parameters which affect the shadows created by
the light source.

Shadow Bias
Controls how far the shadows are “lifted away” from objects

to avoid problems with objects shadowing themselves. In most situations, the default value will work well, but you might encounter two conditions which can be fixed by altering the bias. If the shadows appear “detached” from the objects, with light leaking under the edges of objects, lowering the bias will pull those shadows closer and alleviate the problem. If the shading of objects gets a banded appearance in places where there should not be shadows, the object is shadowing itself, and raising the bias will solve the problem.

Map Resolution
The shadows are generated as bitmaps, and this allows you to control the size of those images. Higher resolutions give sharper shadow edges, but it takes longer to render the shadow maps and uses more memory. Lower resolutions are faster to render, but give much softer edged shadows.

Filter Radius
Defines how big a region of the shadow map the renderer looks at when it determines how much shadow is at a given point. Larger Filter Radius values soften the edges of shadows, and smaller values give harder edged shadows. If the filter radius is too low, the individual pixels of the shadow map appear, and the quality of the shadow edges suffers.

Transform Data
A subset of the general Transform Data is shown for a Radial light source. The Transform Data parameters are explained at the beginning of the Primitives section earlier in this chapter.

Light Editor (for a Spotlight or an FX Spotlight)

Spotlights are like Radial lights, except that the light they cast is directed. The only difference between a plain Spotlight and an FX Spotlight is that creating the FX Spotlight automatically populates the various light gel parameters. The area of light given off by a spotlight grows with distance like a cone. When the spotlight falls on
an object, it forms a circular area of light with two regions: a bright central region and a less bright outer ring that diminishes in brightness the further it extends from the central spot. When the Spotlight is selected and the Pick Tool is active, the RTR representation of the Spotlight shows these two cones. At the end of the Spotlight are three control points. The center control point is the 'point at' indicator. After a spotlight has been placed, this 'point at' indicator can be dragged in the RTR to point the Spotlight at other objects. The other two points allow you to adjust the sizes of the inner and outer cone radii, respectively. The Spotlight Editor also allows you to directly edit the following parameters:

Name
You can edit the name of your light for identification purposes.

Color
Sets the color of the light source. The color can also be set interactively in the RTR via a color dot shown underneath the light object's RTR representation.

Intensity
Controls the intensity of the light radiating from the light source. The total light is equal to the color multiplied by the intensity. The intensity can also be set interactively in the RTR via a greyscale chit shown next to the light object's RTR representation. Setting the intensity in this way only allows for a range of 0 to 1. The intensity can be set to a value outside of that range within the light editor.

Inner Cone

These calipers control the angle of divergence for the center cone of light.

Outer Cone
These calipers control the angle of divergence of the outer cone of light that specifies the secondary region as it reduces in intensity the further it spreads from the center spot.

Falloff and Falloff Distance
See Light Editor (for Radial Source).

Remake GL Preview
See Light Editor (for Radial Source).

Shadows
See Light Editor (for Radial Source).

Gel Effects
The Gel Effects control stack is present for either type of Spotlight object. When creating a Spotlight with the FX Spotlight tool, the various Gel Effects parameters are automatically configured. Items on the Gel Effects Control Stack are:

Enable Gel
This checkbox allows you to enable or disable the color gel effect. It is automatically checked when a color gel is loaded in during the creation of an FX Spotlight.

Gel Color
The Gel Color texture that is automatically created when a color gel bitmap is loaded in during the creation of an FX Spotlight is a color texture consisting of a single leaf whose kickstand is in UV Position coordinates, has no distortion and uses a Bitmap Node. Any MojoWorld color texture can be used for the Gel Color.

Enable Mask
This checkbox allows you to enable or disable the intensity mask effect. It is automatically checked when an intensity gel is loaded in during the creation of an FX Spotlight.

Intensity Mask
The Intensity Mask texture that is automatically created when an intensity mask bitmap is loaded in during the creation of an FX Spotlight is a value texture consisting of a single leaf whose kickstand is in UV Position coordinates, has no distortion and uses a Bitmap Node. When using a MojoWorld value texture, the intensity mask expects a range of 0 to 1.

This DDLB lists all objects currently defined in the world. When an item is selected, the Spotlight will point to that object. The Spotlight's transformations will be constrained relative to the object to which it is locked.

Transform Data
A subset of the general Transform Data is shown for a Spotlight. The Transform Data parameters are explained at the beginning of the Primitives section. See Main Generator Tool Palette, Transform Data.

Transform Palette

The Transform Palette contains tools for moving, scaling, rotating, and automatically cloning the various primitives and
imported models. The Stand and Drop buttons act upon the
currently selected object. It also contains a Dropdown List Box
to describe the space, or spatial coordinate system, in which the
object will be transformed.

Working with Objects in the RTR

When an object is selected, the object bounding box appears. The bounding box assists in transformations of the selected object. The elements of the bounding box depend on which Transform tool is currently active. Clicking the selected object anywhere other than on a control point will advance to the next Transform tool. For most objects, all three Transform tools are cycled through, starting with the Scale tool, moving next to the Translate tool, and then the Rotate tool.

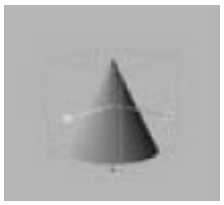
PICK TOOL

With the Pick Tool active, the selected object will show only the bounding box with no additional controls. Using a right-mouse drag on an object with the Pick Tool active moves the camera around the object. This works in the same way as the object spin mode on the JogNav trackball. The object spin mode of the JogNav is discussed in the Bottom Toolbar section later in this section.

SCALE TOOL

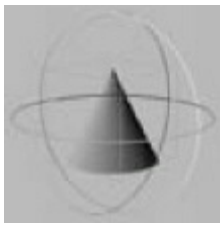
With the Scale Tool active, the bounding box has square control points on each of its corners as well as in the centers of each of its

faces. The corner control points can be dragged to scale the object uniformly by moving the dragged corner while the opposite corner remains fixed in space. Holding the Shift key down while dragging on a corner control point causes the scaling to happen with respect to the object's center. Holding the Alt key down while dragging on a corner control point causes the scaling to be non-uniform. The control points on the centers of the faces can be dragged to scale the object only along the one axis. The bounding box face will highlight to help clarify which of the faces is the one which will move. Holding the shift key down while dragging on a bounding box face control point causes the scaling to happen with respect to the object's center.



TRANSLATE TOOL

With the Translate Tool active, a set of three transform axes appear at the center of the object. Dragging on the control handle at the end of a transform axis will move the object along that axis. When the mouse cursor moves over the central point of the object, the Translate X appears. Dragging an object by its central Translate X moves the object in screen space. Holding down the shift key while dragging an object by the central Translate X moves the object toward or away from the camera. Tapping the Space Bar while dragging an object by the central Translate X will drop a copy of the dragged object. When the mouse is released after creating one or more Space Bar copies, the dragged object will pop back to its original position. The Translate X is available with the Rotate, Scale and Pick tools as well.



ROTATE TOOL

With the Rotate Tool active, a set of three rotate circles appear centered on the object's origin point. Normally an object's origin point coincides with the Translate X. Holding down the Alt key while dragging on the Translate X moves the object's origin point. Holding the Shift and Alt key while dragging on the Translate X will move the object's origin point toward or away from the camera. Moving the origin point allows you to specify an alternate center of rotation. Double-click the origin point to return it to the object's center. Holding down the 't' key while the Rotate Tool is active causes a free rotate 'trackball' to appear around the center of rotation. For a Spotlight which has been locked to an object, the rotate handles and rotate trackball will appear centered on the target object, not on the Spotlight object. Holding the Shift key while rotating constrains the rotations to 45 degrees.

Stamp Tool

The Stamp Tool stamps out instances of the currently selected object. A yellow instance
indicator will show the volume to be occupied by the instance when the Stamp Tool is
clicked at that point. The Stamp Tool has four modes, two of which are extended modes
only available in MojoWorld Pro. These modes are:

Stamp
In this mode, the stamped instances appear at a fixed distance from the camera.

Smart Stamp
With the Smart Stamp, the stamped instances are placed at the same relative position to the ground as the source object. For example, if your source object is sunk into the ground by 2 meters, each of the stamped instances will also be sunk into the ground by 2 meters.

Spin Stamp
The same as Smart Stamp, but also imparts a random amount of rotation about the object's vertical axis. This stamp mode is only available in MojoWorld Pro.

Random Stamp
The same as Spin Stamp, but also imparts a random amount of scaling on each copy. This stamp mode is only available in MojoWorld Pro.

Space Dropdown List Box

Options in the Space Dropdown List Box change the space, or coordinate system in which you can transform your selected object. The default space for object transformations is Object Space. When you change the space in which the object resides, a second orange bounding box corresponding to the alternate space appears and is the one affected by the Scale Tool. The smaller magenta bounding box which corresponds to object space is always shown when an object is selected, regardless of the active tool or current coordinate system.

Universe
The Universe coordinates are fixed in space, and have their origin at the center
of the MojoWorld. As you move around the MojoWorld, the coordinate space
changes. If the RTR Window is at the North Pole of your planet, then the Universe
Z axis (in blue) will point straight up. However, at the South Pole the Universe
Z axis will point straight down. Although the Transform Handles are shown on
the object, all Universe space transformations are relative to the center of the
MojoWorld. This doesn't affect translation, but all rotation will be about the
center of the MojoWorld, and all scaling will scale things towards and away from
the center of the Mojoworld. While not very useful for small objects close to the
MojoWorld surface (as they tend to get scaled and rotated large amounts and
seem to disappear), it can be useful for large objects that you want to place
around the MojoWorld. Rotating in Universe space will keep things the same
distance from the center of the planet, in effect keeping them in orbit.

World
In World space the z-axis runs through the center of the planet and the camera (it
is the intuitive “up” direction). The x-axis points east, parallel to the equator, and
the y-axis points toward the North Pole.

Object
The coordinates in object space are different for each object.

In general the z-
axis points up through the object's medial axis. For a cone, the z-axis runs from
the center of the base through the apex. If the object has no medial axis, then all
coordinates are arbitrarily assigned. Imported models use the coordinate system
originally specified in the modeling program that created the model.

Screen
The axes for the Screen space are always the same. The y-axis is up relative to the
RTR Window, and the x-axis runs parallel to the bottom of the RTR Window. The
z-axis points towards the camera.

Navigation Console

The Navigation Console provides feedback as to where the current camera is located above the MojoWorld.

Compass Wheel
The Compass Wheel indicates the direction that the camera is facing. Dragging with the mouse turns the Compass Wheel. This causes the camera to rotate, and change the view in the RTR Window.

Lat.
Displays the Latitude (degrees North or South of the Equator) of the current camera location. When entering values numerically, use commas to separate degrees from minutes from seconds. Use 'n' or 'N' to specify the Northern Hemisphere and 's' or 'S' to specify the Southern Hemisphere. If no hemisphere is specified, South is assumed.

Long.
Displays the Longitude (degrees East or West) of the current camera location relative to an arbitrary “International Dateline” on the MojoWorld. When entering values numerically, use commas to separate degrees from minutes from seconds. Use 'e' or 'E' to specify the Eastern Hemisphere and 'w' or 'W' to specify the Western Hemisphere. If no hemisphere is specified, East is assumed.

ASL

Displays the camera's current altitude above sea level. This defaults to the planet radius if there is no ocean. When entering values numerically, use 'm' to specify meters, 'km' to specify kilometers, and 'mm' to specify megameters.

AGL
Displays the camera's current altitude above ground level. When entering values numerically, use 'm' to specify meters, 'km' to specify kilometers, and 'mm' to specify megameters. The minimum AGL is 1.0 meters.

Speed
Displays the forward velocity of the camera while walking or flying. If the camera has no forward velocity but is moving sideways, the Speed indicator says the camera is Stopped. If the camera is moving backwards, the Speed indicator shows the absolute value of the camera's velocity. When in Walk mode, the Speed is half the AGL. For example, if the camera is at 10Km AGL and you walk forward, your Speed will be 5000 meters per second.

Editor Stow

When editors are minimized, they appear as icons in the Editor Stow area. Clicking their Editor Stow icons reopens editors. The icon assigned to a particular editor corresponds to the icon that appears in the top left of the editor window when it is open. Editors in the Stow area will show their names as their tool tips.

Bottom Toolbar

Bottom Toolbar
The bottom toolbar tabs are associated with extra information and controls which are
displayed in the RTR window. Most of these tabs have a small circle in the upper right.
This is the Lock Open widget. When clicked, the widget toggles between a dash and
an up-arrow. The dash indicates that the associated RTR display will fade in and out
as needed depending on the location of the mouse pointer. When the up-arrow is
displayed, the associated RTR display is locked open and will not auto-hide until the
Lock Open widget is clicked again. Shift-clicking the Lock Open widget changes the
dash to a down-arrow. This locks the tool closed and it will not appear until the Lock
Open widget is clicked again to put it back into either its dash or up-arrow states.

Object Properties

When an object is selected, this area reads out statistics about the object, depending on which tool is active. For the Scale tool, the information shown is the object's dimensions in world space. The Translate tool will show the object's Latitude, Longitude and the Altitude of the object's center point above the current terrain. The

Rotate tool shows the object's rotation relative to world space. When the Crop Window is active, the location of its upper left corner relative to the RTR is shown in terms of X pixels down and Y pixels to the right. The size of the Crop Window is also shown. When the Field Of View widget in the JogNav is used, a numeric readout of the camera's FOV is dis-played in the Object Properties area. The Object Properties cannot be locked closed,
as the display of Object Properties is either on or off.

SmartGuides

There are two icons in the SmartGuides tab. The first of these is the Ground Lines control. When the Ground Lines are enabled, the currently selected object will show a vertical yellow line extending from the object's center point down to the planet's surface. Also drawn on the planet's surface is a yellow dashed box indicating the area the object would occupy if it were dropped to the ground. The Ground Lines are a very powerful
tool for visualizing the positioning of objects in the planetary context of MojoWorld.

The second icon in the SmartGuides tab is the Alignment Guides control. When the Alignment Guides are enabled, they will be shown as yellow or orange lines extending between the currently selected object and any other objects with which the selected object aligns. The Alignment Guides are orange when the objects are at the same altitude. When the Alignment Guides change from orange to yellow, the objects are not only at the same altitude, but they also align with respect to a control point (face center or corner) on the selected object. Alignment Guides are most useful when using the alternate views provided by the MojoViews tool.

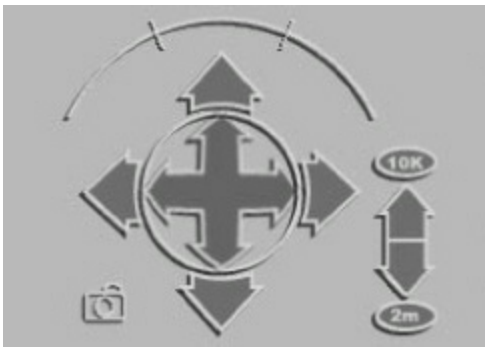
See JogNav

See MojoViews

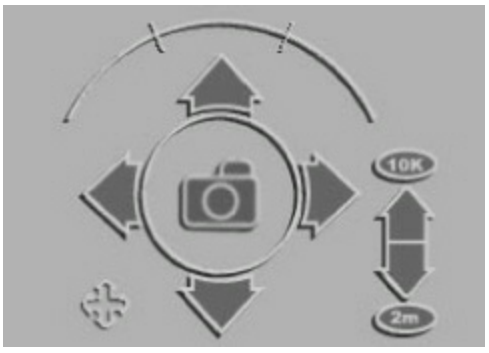
See RandomCam

JogNav

The JogNav works just as it does in the Viewer UI, except that it is not always on unless it is locked open. The JogNav will appear any time the mouse goes within the JogNav tab and then remains over the JogNav area. The JogNav can be locked open by clicking the circle to the upper right. Shift-clicking that circle will lock the JogNav closed and will keep it hidden until this circle is clicked again to restore it back to the show on mouse-over behavior.



The camera icon appears in the lower left corner
when an object is selected. Hold the Alt key to
switch to camera tilt mode.



The JogNav in Object Spin mode

An additional icon, a camera, will
appear in the lower left corner of
the JogNav only when an object is
selected.

Clicking the camera icon changes
the trackball behavior to spin around the selected object (Object
Spin mode). While in this mode,
the trackball displays a camera
icon on it instead of the crossed
arrows. The icon in the lower left
changes to the crossed arrows. To

	change back to the normal JogNav trackball behavior, you can either click the crossed arrows icon in the lower left or simply de-select any objects.

MojoViews

Mousing over the MojoViews tab causes the MojoViews Control Widget to appear in the RTR. In MojoWorld Standard, the MojoViews widget lets you switch between your current camera view and a top-down view.

In MojoWorld Pro, the widget is a central circle surrounded by six smaller circles which represent six alternate views: Top, Front, Right, Bottom, Back, and Left. The MojoViews Control Widget remains visible as long
as an alternate view is chosen, or if the Lock Open widget has been set.

Clicking on one of the six smaller circles switches the view to that alternate view. The center of the alternate view will be either the currently selected object or, if no object is selected, the current camera. Once an alternate view has been selected, the small circle turns red. By dragging on the small red circle, you may zoom your view in or out. The zoom is limited. It can only zoom in as far as the surface of the selected object,
and it will only zoom out until the selected object's bounding box appears the same size as a bounding box control point. Switching among the alternate views will cause the zoom to be reset when going back
to a previously zoomed alternate view.

RandomCam

Mousing over the RandomCam tab causes the RandomCam ViewStack to appear in the RTR. Initially, this stack is empty. The RandomCam tools allow you to explore your MojoWorld in a series of random jumps. At any interesting point along the way, you may add your current view to the RandomCam ViewStack. Note that any change to your planet, no matter how small, will cause the ViewStack to be emptied!

The three icons in the RandomCam tab are a six-pip die, a two-pip die and a plus icon. As with other Randomize buttons, the six-pip die makes a large change, putting the camera most anywhere on the lit side of the planet, and the two-pip die makes a small change, put-ting the camera somewhere close to where it is when the two-pip die is clicked. The plus icon is used to add the current view to the ViewStack.

The bottom-most slot in the RandomCam ViewStack is the “where I started” location. This slot fills in the first time any of the RandomCam controls are clicked. All subsequent additions to the RandomCam ViewStack are added by clicking the plus icon. A thumbnail will display its Latitude and Longitude coordinates when the mouse pointer hovers over it. You may go back to any location at any time by clicking the thumbnail. Holding down the Shift key and clicking on a RandomCam thumbnail will create a camera at that location. The camera will be named Random-Cam and a two-digit sequential number.

To the right of the “where I started” thumbnail at the base of the ViewStack are three additional icons:
The top icon is a punch-button widget. Clicking this clears the ViewStack. Remember, the ViewStack is also cleared when any change at all is made to the planet, including changing the Time of Day!
The middle icon starts out as an arrow which looks like the Pick Tool icon. Clicking this icon cycles through the arrow, the walking man, the airplane, and the UFO icons. This controls the altitude preference for the six-pip die. With the arrow displayed in this spot, clicking the six-pip die will place the camera at random locations around the lit side of the planet, but will do so at altitudes which are close to the altitude of the camera before the six-pip die was clicked. With the walking man displayed in this spot, the camera altitudes generated by the six-pip die will be in the neighborhood of 5 meters.

When the airplane is displayed here, the camera altitudes generated by the six-pip die will be in the neighborhood of 10 kilometers, and with the UFO displayed, the six-pip die will place the camera at altitudes in the neighborhood of 500 kilometers. All of these altitudes are ranges which randomly vary by plus or minus 15 percent.

The bottom icon is the satellite dish representing the Uplink Queue. Clicking this icon will open an Operating System-specific File dialog. After specifying a folder, a base name and a file type, MojoWorld will create Uplink Queue jobs at the current render setting for each item in the RandomCam ViewStack and will open the Uplink Queue Editor showing the jobs in the queue. The jobs will all be of the same file type and render setting and the destination file names will have a sequential number appended to the base name.

Editors in the Generator Interface

All the editors in the Generator Interface are designed to have similar workflow. They share a common layout that includes a Title Bar, a Tool Bar, and a Control Stack.

The Editor Name appears on the left of the Title Bar, and three icons appear on the right: Stow, Maximize, and Close. The Stow icon minimizes an editor to the Editor Stow area of the main Generator Interface. Maximize expands an editor on the screen. The Close icon dismisses an editor.

An icon appears on the far-left end of each editor's toolbar. This icon is used to designate editors of this type when stowed in the Editor Stow area. Next in the Editor Toolbar is the Options Menu Button. This menu presents options to create new items to be edited, as well as other editor-specific options. On the right end of the toolbar are Pause and Jump buttons.

Pause and Jump
Pause and Jump affect whether the RTR Window is updated as each parameter is changed. If the Jump button is active (the default), changes made to parameters in the editor should show up in the RTR Window shortly after the parameter change is made.

Pause

Each change to a MojoWorld parameter generally, though not always, requires MojoWorld to perform a Hyperspace Jump. This means reconstructing everything, the entire MojoWorld, from scratch. For simple MojoWorlds on fast machines, this can happen pretty quickly. For complex MojoWorlds and/or slow machines, it can take a while.

That's when you want to use the Pause button: pause MojoWorld, make a bunch of changes, then hit Jump and take the hit for the Hyperspace Jump only once!

It is important to note that not all changes are visible in the RTR. For example, changes to terrain shape are usually visible, but changes to the surface of a moon will not be, as currently a moon is shown in the RTR as a simple wireframe object.

Turning Pause mode on in any editor turns it on for all editors. When working on a very complex MojoWorld, pausing while you make changes can speed up working in the various editors dramatically. After making the desired changes, click the Jump icon to see the changes in the RTR. This activates Jump mode for all editors and Jump mode is active until it is paused again.

Note: What can be seen in the RTR Window is not entirely up to Pandromeda's
engineers. MojoWorld relies on state of the art graphics accelerator card
technology for the RTR, to make it run as fast as it possibly can. What
those graphics cards can render is limited by their hardware specs and the
OpenGL graphics standard to which they adhere.

The first thing to try if you experience crashes with MojoWorld, especially
at start-up or during navigation, is to make sure you have the proper video
drivers for your graphics card and that those drivers are properly installed.
Improper graphics drivers are responsible for over 90% of the

technical
support issues for users of earlier MojoWorld versions.

Control Stacks

The main window of each editor contains a Control Stack. While Control Stacks take different forms, their basic layout is always the same. Each parameter of the object being edited is displayed on the Control Stack. Next to each parameter is either a Controller Widget or a Drop Down List Box, which you will often find abbrevi ated as DDLB. (The official Mojonaut pronunciation of this is “deedle-bee.”)

When a Controller Widget is present you can change a parameter's value with the Controller Widget, or by highlighting the value with the mouse and typing in a new value. Double-clicking most numeric values will select the whole field for type-over.

Parameters and Textures

A Controller Widget may also have a semicircle next to it. This semicircle indicates that the parameter may be driven by a texture or a Function Graph. Click the semicircle to attach a new texture to the parameter.

In the Pro version, a Controller Widget may also have a semisquare next to it. This semisquare indicates that the parameter may be driven with a Function Graph. The semisquare is only available when the 'Force Functionable' preference is set. Parameters which get a semisquare instead of a semicircle are not designed to be driven with a generic fractal texture, however there are many non-fractal-based Function Graphs that would be appropriate for these parameters, such as defining a Hyperspace Mixer or setting up some sort of MojoMove animated capability.

Parameters that are already driven by textures show a Circle-T icon. Clicking this opens the Texture Editor. If the parameter is driven by a Function Graph, the parameter's controller widget is replaced with a Circle-F icon. Clicking this icon opens a MojoGraph Function Graph Editor containing that Function Graph. Access to the MojoGraph editor is only available in MojoWorld Pro.

Common Editor Controls

The MojoWorld Generator Interface is built from a relatively small set of common controls. The following list of widgets covers most of the Controller Widget types. A few specialized controls are discussed in the sections corresponding to the editor in which they are found.

Calipers

Calipers specify angles between 0 and 180 degrees, inclusive.
Calipers are used for camera field of view and the spread angle of spotlights. Drag down on the Calipers widget to open them,
drag up to close them.

Change Directory

The Change Directory icon is only found in the Library Importer dialog.

Checkbox

A Checkbox is a circle that can either be empty (unchecked) or contain an
x (checked).

Color Dot

Color Dots specify a single color (as opposed to a Gradient). Clicking a
Color Dot invokes the Color Picker.

Color Picker
Clicking on Color Dots opens the Color Picker. The Color Picker contains two graphic displays
and six numeric displays. Both RGB (Red, Green, and Blue) and HSV (Hue, Saturation, and Value)
values for the selected color are shown. Color is a three-dimensional space; MojoWorld's Color
Picker has tools to navigate these three dimensions quickly and accurately

The box on the left of the Color Picker is the Saturation Preview. The Saturation Preview is divided into two areas. The area at the bottom displays the previously selected color, or the color that you began with when you entered the Color Picker. The area at the top displays the color currently selected. These two colors are displayed abutting one another for sensitive and effective comparison. There is a Saturation Slider on the right hand side of the Saturation Preview. Saturation controls whether a color is intense or washed-out. When the slider is at the bottom the selection colors displayed are monotone. When the slider is at the top of the bar it corresponds to full saturation, or the brightest colors you can get.

The box on the right of the Color Picker displays the two dimensions of Hue and Value graphically. Hue describes the shade of color: red, green, blue, yellow, etc. Value describes the overall brightness of colors, from black to full brightness. The red dot in the display shows the position of the currently selected color in this two-dimensional space. When you drag on the small red square, it changes the color in the current color portion of the Saturation Preview. Moving the red square left and right changes the Hue, up and down changes the

Value. The bar along the bottom of this display is a monotone bar on which you can adjust gray levels. The saturation here is always zero.

The RGB boxes describe the current color numerically in red, green, and blue primaries. The HSV boxes describe the current color in terms of hue, saturation and value. The values in any of the boxes can be selected and directly set via your keyboard. To accept any changes made in the Color Picker click OK. To return to the previous color click Cancel. No other part of the Generator Interface can be used while the Color Picker is open.

Control Stack Expand/Collapse Toggle

This icon contains an arrow that points either right or down. When the arrow
points right, the Control Stack is collapsed. When the arrow points down,
the Control Stack is expanded. A click toggles between expanded and
collapsed.

Curve Editor

Opens the Curve Editor. The Curve Editor is described in detail in the
Reference section of this manual.

Delete Item

Deletes the currently selected item. This icon appears in the Uplink Queue
and Object List.

Dropdown List Box

A Dropdown List Box, or DDLB, presents a list in which only one item may be active at a time. Clicking on a list item selects it and closes the list. There are three styles of DDLBs: One has a small bracket and down-pointing arrow to the left of the selected item. The second has a larger circle with an arrow in it, to the right of the selected item.
The third has a rounded half-square with an arrow in it to the left of the selected item.

Duplicate Item

Duplicates the selected item. This appears in the Uplink Queue and
Object List.

Eyeball

The eyeball icon indicates whether an object is visible or invisible. If the eyeball is at normal intensity, the object is visible (assuming the current view contains the object). If the eyeball is greyed out, the object is hidden regardless of the current view.

Gradient Editor

Opens the Gradient Editor. The Gradient Editor allows you to add color gradients to color selections. The role of the Gradient Editor is covered in the Texture Editor Tutorials.

In the top-most section of the Gradient Editor there is an Options Menu, a pair of Randomize Buttons, and then Cancel and OK buttons on the right. The Gradient Editor is a Modal dialog, meaning that you cannot access the rest of the MojoWorld

interface while a Gradient Editor is open. Click the Cancel button to close the Gradient Editor without accepting any changes. Click the OK button to apply your Gradient changes to your MojoWorld.

The Gradient Editor Options Menu allows you to load Gradients from file, and save
them to file. Selecting one of these options opens the Library dialog for Gradients.
See the Library section for more information on working with Library dialogs.

Load Gradient From File
This option opens the Gradient Library Importer.

Save Gradient To File
This option opens the Library Exporter associated with the Gradient Editor.

Gradient Editor Randomize Buttons
Clicking on the Randomize Buttons introduces random changes in the Gradient
Editor. The die with two pips changes the current gradient in a slight way. The die
with six pips creates an entirely new gradient. See the Randomize Buttons entry
for more information.

Gradient Preview
The Gradient Preview is the large color bar at the top of the Gradient Editor window. Initially the Gradient Preview displays the entire range of the color gradient. You can use the zoom controls to magnify sections of the Gradient Preview. When you zoom in on a section, the entire gradient range is still displayed in a thin bar along the top of the Gradient Preview.

To add Control Points to a Gradient, click at the desired location in the Gradient Preview. The colors at these Control Points may be changed in the Control Stack for the selected point. Control Points can be moved by dragging them beneath the Gradient Preview. To delete a Control Point, select the point and then press the Delete key.

Gradient Editor Control Stack
The items on the Gradient Editor Control Stack affect the single Gradient Control Point which is currently selected. If no Gradient Control Point is selected, these parameters will have no effect.

Color Dot
Opens the Color Picker. Lets you select the color of a Control Point in the Gradient.

Gradient Position
Moves the current selection in the Gradient Preview.

Red, Green, and Blue
These sliders specify the RGB color values of the current selected Gradient Control Point.

Home Icon

Clicking on this icon returns the library browser to the home library folder. The default home for the libraries is a folder named Libraries in the install directory for the main application. See the Libraries section for more information on the folder structure of the Libraries.

Jump Icon

Click the Jump Icon to restart the RTR from a paused state. (Remember to use the Pause button before making a lot of changes to your world; then hit Jump and take the hit for the Hyperspace Jump only once!) The Jump Icon also shows up in the Uplink Queue and Log Editor. These occurrences of the Jump Icon transport you back to the planet and camera position saved in the individual Uplink Queue jobs and Log Editor entries.

Material Editor

Opens the Material Editor. Multiple Material Editors may be open at once. The Material Editor is one of the two most significant editors in the MojoWorld Generator Interface. It is discussed in detail later in this section.

Menu Button

This icon opens a pop-up menu. The menu options differ from editor to editor.

Punch Button

This icon is used on objects to send those objects a one-time signal, such as telling a forest to recalculate itself or telling boulder to randomize itself. The widget is a square with an x in it which appears briefly when clicked, but immediately after the click, the widget returns to its original state.

Range/Zoom Controls

Use the Range/Zoom Controls to magnify sections of Gradients

and Curves. In the Curve Editor, moving one end causes the other end to move symmetrically about the center between the two end points.
Dragging the middle of the Zoom Control pans the zoomed area back and forth.

Radial Control

Radial Controls specify angles between 0 and 360 degrees. Drag the arm around either clockwise or counter-clockwise to decrease or increase the angular value. For finer control, either drag with the shift key held down or drag further away from the control. Radial Control values can also be entered directly from your keyboard.

Randomize Buttons

In any editor in which these buttons appear, they allow you to randomize the current item at hand. The die with six pips creates an entirely new random item and the die with two pips changes the current item in slight ways.

On the Texture, Material, and Gradient editors, you will find extra icons next to the randomize icons: The Undo/Redo arrows and the Commit/Discard Tick and Cross Buttons. The Undo/Redo arrows allow you to browse the last ten random items you have created. Use the Commit button to accept your new randomized item into the scene, and use the Discard button to discard any new random changes and return to your original item.

Save to File / Load from File

The Save to File icon opens an operating system dependent file-finder

dialog. Appropriate extensions are added to saved filenames, as determined by the Editor. This icon is also used in the Library importer dialogs to bypass the library browser and go directly to a specific file.

Scroll Tabs

A Scroll Tab is a tab attached to a vertical line, or Scroll Bar, next to a list. This tab may have a small arrow on either end, indicating that there are more items in that direction. Drag on the tab to scroll the list. Some Scroll Bars are resizable. This is indicated by a small gap in the vertical line just above the bottom of the line. Drag up or down on the gap to expand or contract the visible area of the list. Scroll Bars may appear either to the right or to the left of lists. They may be solid or they may be indicated with outlines.

Slider

A Slider changes a single numerical value, within a predetermined range. This value can also be changed directly by highlighting it with the mouse then entering a new value from your keyboard. If that value falls out-side of the slider's range, it is set to the nearest limit value of the slider.

Sub Plug-in Editor

The Sub Plug-in Editor icon looks much like the Control Stack Expand/ Collapse icon, but it opens an entirely new editor window rather than expanding the current control stack. The most common occurrence of the Sub Plug-in Editor icon is on the Basis Function parameters of the various Fractals, and on the

Render Object and Light Source parameters for the sun and moons. The Sub Plug-in Editor is also found in the editors for MojoTree.

Texture Editor

Opens the Texture Editor. Like the Material Editor, multiple Texture Editors may be open at once. The Texture Editor is the most important editor in MojoWorld. It is covered in detail later in this section.

Thumb Wheel

A Thumb Wheel is used to change a single numerical value. Dragging left on the Thumb Wheel decreases the value.

Dragging right increases the value. The numeric value may also be highlighted and an exact value entered from your keyboard. For parameters that are restricted in range, the Thumb Wheel does not go above a predetermined maximum value or below a minimum. Values entered from your keyboard are similarly limited.

Modal, Single, and Multiple Editors

Editors in Generator come in three flavors: Modal, Single, and Multiple. Modal Editors “take over” and must be dismissed before you can use any other part of MojoWorld. Only one Single Editor may be open at a time. If you try to open another, the first simply pops up. Several Multiple Editors can be open at a time, working on different objects.

The following table lists the Editors in MojoWorld as Modal, Single, or Multiple.

Modal Editors	Single Editors	Multiple Editors
Color Picker	Camera Editor	Basis Function Editor
Curve Editor	Hyperspace Mixer	Image Window
Export QTVR Wizard	Land Editor	Light Editor
Export Terrain Wizard	Log Editor	Material Editor
Gradient Editor	MojoMove Editor	Parameter Bomb Editor
Import Terrain Wizard	Moon Editor	Primitive Editor
Layout	Movie Editor	(includes the various
Library Exporter	Navigation Editor	MojoTree editors)
Library Importer	Object List	Texture Editor
Parameter Bomb Terrain	Render Window	
Exporter	Sky Editor	
Parameter Bomb Terrain	States Editor	
Importer	Sun Editor	
Planet Wizard	Time Editor	
Preferences Editor	Uplink Queue Editor	
Render Settings Editor	Water Editor	

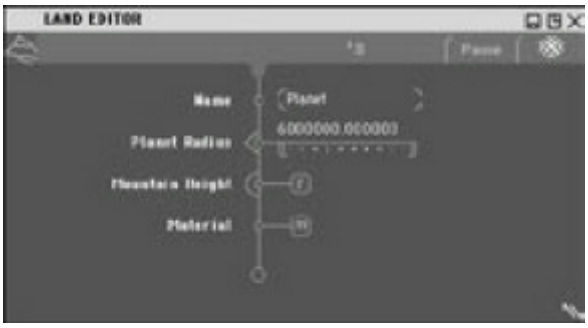
Global Parameters Editors/Land Editor

This section deals with the Global Parameters Editors. First we'll cover the Land Editor and its associated Material and Texture Editors. Then we'll tackle the Water Editor and its associated Material Editor. Finally, we'll look in detail at the Sky Editor, Moon Editor, Sun Editor, and Stars Editor. There are tutorials for each editor to help you develop your skills with the MojoWorld Editors. When you've gone through all of these tutorials, you will have built an entire MojoWorld from scratch!

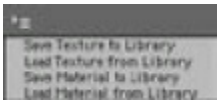
Land Editor Hot Buttons

The three bottom icons in the Global Parameters Hot Buttons all refer to the land portions of the planet. The Mountain Icon is the Land Editor. The Circle-T and Circle-M icons are shortcuts to two parameters within the Land Editor.

The Land Editor Title Bar has the standard Stow, Maximize and Close buttons. The next row displays the Land Editor Icon on the left, a Menu Button toward the middle, and the Pause and Jump buttons on the right. The Land Editor Icon identifies the Land Editor when stowed in the Editor Stow area.



Land Editor Options Menu



The Land Editor Options Menu gives you access to Save and/ or Load your Land Texture and/or your Land Material to or from the Library. See the Library section for more information on working with Library dialogs.

Save Texture to Library
This option opens a Library Exporter dialog to save the current Land Texture to a Library file.

Load Texture from Library
This option opens a Library Importer dialog to load a new Land Texture from a Library file. The current Land Texture will still be available on the DDLB in the upper left corner of the Land Texture Editor.

Save Material to Library
This option opens a Library Exporter dialog to save the current Land Material to a Library file.

Load Material from Library
This option opens a Library Importer dialog to load a new Land Material from a Library file. The current Land Material will still be available on the DDLB in the upper left corner of

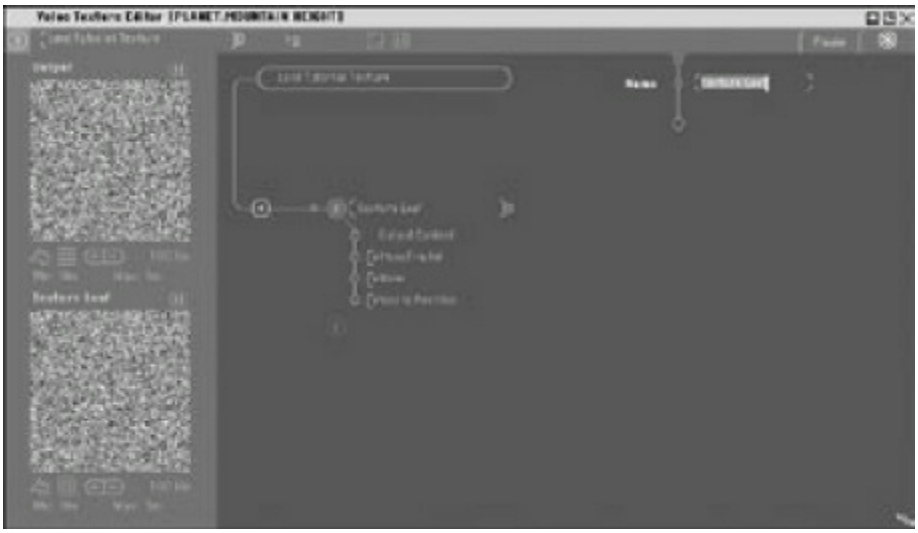
the Land Material Editor.

The Land Editor has a small Control Stack containing parameters to change your MojoWorld's name and radius and to define the planet's shape and coloration via the Mountain Height and Material parameters. The Planet Radius is measured in meters and may be modified with the Thumb Wheel or directly from your keyboard. The default value is 6 million meters, which is approximately Earth's radius. The Mountain Height parameter defines the shape of the terrain. The Circle-T Global Parameters Hot Button is a shortcut to the editor for the Mountain Height parameter. The Material parameter in the Land Editor's Control Stack opens a Material Editor with which to edit the material applied to the planet. The bottom-most Circle-M icon in the Global Parameters Hot Buttons is a shortcut to the planet material editor.

The Texture Editor

Textures have many uses in MojoWorld. There are two types of textures in MojoWorld: Color Textures and Value Textures. The title of the Texture Editor dialog will indicate the type of parameter to which the texture is assigned, however, you can't ever be sure whether a texture leaf is a Color Texture Leaf or a Value Texture Leaf without explicitly looking at its Output Controls.

The Land Texture is a special type of value texture. It controls the shape of the terrain on the MojoWorld. This means there are some differences between the Land Texture Editor and Texture Editors used to edit color or value textures used for purposes other than shaping the terrain. The discussion of the Texture Editor which follows will note the differences between the Land Texture Editor and the more general Texture Editor. To access the Texture Editor associated with the Land Texture, click on the Land Texture Editor hot button below the Land Editor hot button in the Global Parameters hot button bar.



The Texture Editor window has a Title Bar with the standard Stow, Maximize and Close buttons. Below that appears the Texture Editor icon on the far left, and beside that a DDLB that displays the name of the currently selected Texture Tree. This DDLB manages the different textures that may be edited in the Texture Editor. The options in the Texture Editor Options Menu all relate to the currently selected texture.

Texture Editor Options Menu

New Texture

Opens a new Texture Tree with a default name consisting of the words “Main Texture Node” and a two digit number. It is recommended that you name your textures as you create them.

Clone Texture

Duplicates the selected Texture Tree. The name of the cloned copy is the same as the selected texture with a sequential number appended. A clone of “texname” becomes “texname01.” A clone of “texname01” becomes “texname02,” and so on. The clone becomes the currently selected Texture

Tree.

Delete Texture
Deletes the currently selected texture completely, and removes it from all other objects to which it is assigned. The texture will no longer be available in the Texture Editor DDLB.

Remove Texture
This option clears the currently selected texture and removes it from the parameter to which it is currently assigned. The texture remains available in the Texture
Editor DDLB.

Save to Library
Saves the currently selected texture to a Texture Library file on your disk. If you are saving a Land Texture, the 'home' Library folder is named LandTextures. If you are saving a color texture, the 'home' Library folder is named Color and is a sub-folder of a folder named Textures. If you are saving a value texture, the 'home' Library folder is named Value and is also a sub-folder of the Textures library folder. See the Libraries section for details on the use of the Library Exporter.

Load from Library
Loads a texture from a Texture Library file. The 'home' Library folder used by the Library Loader will depend on the context of the parameter being textured. See the Save to Library description above for the specific 'home' Library folder associations.

Tidy Up...
This option opens the Node Janitor.

Use the Node Janitor to delete textures, texture leaves, materials, material leaves, and function nodes that are not currently used (they are not contributing to the current MojoWorld scene at all). Simply click on the Rubbish Bin
icon associated with the nodes you wish to delete. To clear all unused nodes, click on the top Rubbish Bin icon. This is a great

help to reduce 'clutter' in your current MojoWorld scene.

Preview Swatches
The two preview windows on the left of the Texture Editor allow you to see the results of your blends. The top preview window displays the final result of all the blends on the Texture Tree. The bottom preview window displays the effect of the currently selected Texture Leaf or Blend.

Preview Swatch Tools

Tools at the bottom of each preview box control the view displayed. These tools may or may not be present, depending on the context of the texture being edited.

Mountain Icon
The Mountain Icon is present for any texture which participates in the Land Material. It will not be present for textures used in other contexts, such as cloud layers or on imported models, and so forth. When the Mountain Icon is present, the preview swatch defaults to 'planet sampling' mode. The terrain model used to preview the texture is an actual sample of your current planet based on the location of your current camera. If your current planet has no land texture, the preview swatch will be fl at. Clicking the Mountain Icon to disable 'planet
sampling' mode will draw an X through the Mountain Icon and will

use a default terrain swatch for the preview. Click the Mountain Icon again to return to 'planet sampling' mode.

Grid Icon
The Grid Icon is present any time that the Mountain Icon is present. It is also available for any Value texture. This icon toggles between a flat preview and a 3d model preview. When editing any Value texture, changing to the 3d preview mode will represent that Value texture as a height field. If that Value texture is outputting a very small range of values, the 3d preview will appear flat. When the preview is in the 3d model view, it can be rotated by dragging on it with the mouse. Click the Grid Icon again to return to the flat preview mode.

+ - Zoom Icons
The + and - Zoom Icons allow you to zoom in and out of the texture preview swatches. These icons are always present. The default zoom level altitude is 100Km. Each zoom level approximately doubles or halves the previous altitude. For example, zooming out from 100Km will stop at 200Km, 400Km, 800Km, 1600Km, and so forth. A zoom level of 12Mm (one zoom level beyond 6400Km) shows a flat representation of the texture at the size of the planet for planets which use the default radius. Going down the other direction from 100Km, the zoom levels stop at 50Km, 25Km, 12Km, 6250m, 3125m, 1562m, 781m, 390m, 195m, 97m, 48m, 24m, 12m, 6m, 3m, and 1m. Note that this is where the “approximately halves” comes in; 390 is an approximation of half of 781. These specific zoom level altitudes will help you decode the names of the preset color and value textures found in the Textures folder of the preset Libraries. The first 6 characters of the preset textures indicate the zoom level of the thumbnail, thus giving you an indication of the scale of that texture's features. For example, the thumbnail of a texture named, “zk0012_pkc410COLT.mjl” seen in

the library loader will be what the preview swatch will look like in the Texture Editor when zoomed to 12km, according to the “k0012” part of the name. This convention allows the Textures libraries to be sorted by scale .

Altitude Readout

The Altitude Readout will always indicate one of the fixed altitudes as described above in the + - Zoom Icons section. The Altitude Readout is always present.

See Land Texture Editor/Texture Tree

Land Texture Editor/Texture Tree

The Texture Tree
The Texture Tree in the Land Texture Editor controls the parameters that combine to give the shape of the terrain on your MojoWorld. Texture Trees in other Texture Editors work in similar ways. Texture Trees are made up of Texture Leaves which combine in ways defined by you to give an amazing variety of effects. Up to four Texture Leaves may be added.

Texture Leaf Buttons
To edit a Texture Leaf, left click on the Texture Leaf Button (Circle-T) beside the Leaf. Left clicking on the fainter Texture Leaf Button below creates a new leaf, if you have fewer than four leaves. The currently selected leaf has a red dot behind it.

If you right-click on a texture leaf an option menu relating to that leaf appears. You can choose Clone, Remove, or Delete from this menu.

Clone will copy the current texture leaf, leaving the original untouched. Remove will remove the texture leaf from its position on the tree. Delete will remove the leaf from the tree as well as delete it from the MojoWorld scene entirely (possibly affecting other textures which may be using it).

Clicking on the Texture Leaf DDLB itself will list all currently defined texture leaves in the MojoWorld scene. The leaves will be sorted by type, so if you are in a Value Texture Editor, value texture leaves are listed first followed by color texture leaves. If you are in a Color Texture Editor, the color texture leaves will be listed first followed by the value texture leaves. Another option on the Texture Leaf DDLB is “Convert to Function.” This is one place where the MojoGraph Function Graph Editor may be launched. MojoGraph is explained in the next section.

Adding a Leaf to the Texture Tree
You add a leaf to the Texture Tree by left clicking on the Texture Leaf Button below, and not connected to, the Texture Tree. Once it is selected it becomes part of the tree and the new leaf appears. This new leaf can be edited in the manner described above. You can add up to a total of four Leaves to the Texture Tree.

Defining the Parameters of a Texture Leaf
To set the parameters of a Texture Leaf, left click on the Texture Leaf Button. This causes a small Control Stack
to appear under the leaf. This is called the Kickstand.There are three Drop-Down List Boxes and a button on
the Kickstand. The flow of data is from the tail end of the kickstand up into the Texture Leaf and then into the Texture Tree. Examining the controls in data-flow order, they are:

Input Coordinate DDLB
The tail-end DDLB refers to the coordinates in which the texture works. The default is “World Position” which evaluates textures in the coordinate system of the MojoWorld. For the purposes of creating a Land Texture, this is by far the most common input coordinate to use. Other coordinate systems for the Land Texture may be available under certain circumstances, as when using Parameter Bombs. See the Node Reference for the definitions of the available input coordinate nodes. Third party plug-ins may insert additional entries into this list.

Tip

Here is the first key difference between the Texture Editor for creating

your Land Texture and any other Texture Editor. Only a few input coordinates are valid for creating the Land Texture. Many other input coordinates available to non-land textures are defined by the land texture itself, such as Altitude or Slope, so you will not see those inputs in the Land Texture Editor.

Distortion Function DDLB
The Distortion Function uses a fractal or noise to smear and distort the space of the coordinates. The options in this box are defined in the Node Reference section of the manual.

Primary Function DDLB
In the Land Texture Editor, the Primary Function specifies the texture that provides the terrain relief (the mountains). The options in this box are defined in the Node Reference section of the manual.

Output Control
The Output Control button opens a Control Stack that has a structure dependent on the parameter or blend that the texture drives. There may be one or three items on the Control Stack, depending on the texture type. For value textures, such as the Land Texture, there is a single Input Curve. Color textures will also have the Input Curve icon, and they will have Gradient and Output Curve icons, both of which will be covered in the Material Editor section.

Blending
When you add a leaf to the tree you must define the relationship between the old leaf and the new one. Texture Trees combine Leaves in various ways to produce visually interesting results. Combining the effects of Leaves is called blending.

Blending Leaves on the Texture Tree
When you have two or more Leaves on the Texture Tree a Blend Control Button appears at the intersection on the tree of the Leaves to

be blended. Click on this Blend Control Button to define the conditions of the blend. A DDLB appears with the following entries: Average, Add, Subtract, Multiply, Minimum, Maximum, Slope, Altitude, and Blend. The default blend is Maximum. The Slope and Altitude Blends are not available in the Land Texture Editor or in any Texture Editors which otherwise tie back to the Mountain Height parameter (for example, any texture used to drive a parameter of any fractal used in the Land Texture Editor). When the root parameter being driven is anything other than the Mountain Height, such as any parameter associated with the Land Material, the Slope and Altitude Blends will be present.

Average
Adds the values of the leaves being blended, then halves the result.

Add
Adds the values of the leaves being blended.

Subtract
Subtracts the second leaf's value from the first.

Multiply
Multiplies the values of the leaves being blended.

Slope
Varies the blend based on the slope of the underlying terrain, using the Curve
Editor. The Curve Editor Icon appears under the Blend Control DDLB. This blend
type is not available in any Texture Editor which ties back to the Mountain Height
parameter, but will be available in other Texture Editors.

Altitude
Varies the blend by the altitude of the terrain, using the Curve Editor. The Curve

Editor Icon appears under the Blend Control DDLB. This blend type is not avail-
able in any Texture Editor which ties back to the Mountain Height parameter, but
will be available in other Texture Editors.

Minimum
Compares the values of the two leaves and takes the minimum of the two as the
result.

Maximum
Compares the values of the two leaves and takes the maximum of the two as the result.

Blend
If you select the Blend option on the Blend Control Button the blend will be controlled by a new Texture Leaf with its own Kickstand. The kickstand structure of this Blend Texture Leaf works the same as the one that appears when you left-click on a Texture Leaf Button. Using the DDLB at the top of this Kickstand, you may select a leaf that has been used elsewhere on the current Texture Tree or a leaf from any other Texture Tree defined in the current MojoWorld Scene. Or, you may edit the new Texture Leaf to meet your blending needs. Refer to the section above on “Defining the Parameters of a Texture Leaf” for more details of this Kickstand. The output of the Texture Leaf used for a Blend should be in the range of 0 to 1, where a value of 0 causes the texture to take its result from the upper portion of the tree, a value of 1 causes the texture to take its result from the lower portion of the tree, and values between 0 and 1 cause the texture to blend the results from the upper and lower sections of the tree proportionally.

Additional Controls on the Texture Tree
A Texture Tree may have a maximum of four Leaves. When you have four Leaves, an additional Graph Layout Button appears on the Tree. When you click the Graph Layout Buttons, the Texture Tree changes shape. The Texture Tree shape determines the way in which the four

Leaves are blended.

Figure 1 displays the Texture Tree when the top Graph Layout Button is selected. In this layout, the bottom two leaves are blended and the result is blended with the next leaf up. The result of this blend is blended with the top leaf. Figure 2 displays the Texture Tree if the bottom Graph Layout Button is selected. In this layout, the top two leaves and bottom two leaves are blended, and these two blends are blended.

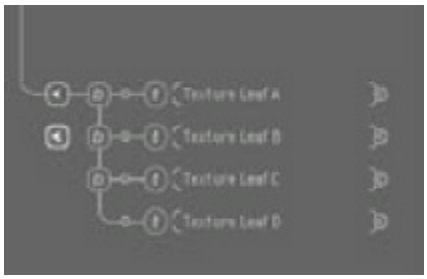


Figure 1

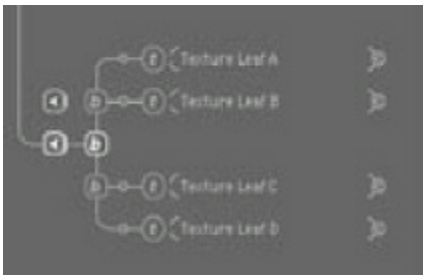


Figure 2

For the mathematically-minded user, the two configurations of the Texture Tree can be compared to the two equations (a . (b . (c . d))) and ((a . b) . (c . d)) where the dots represent the Blend node operations.

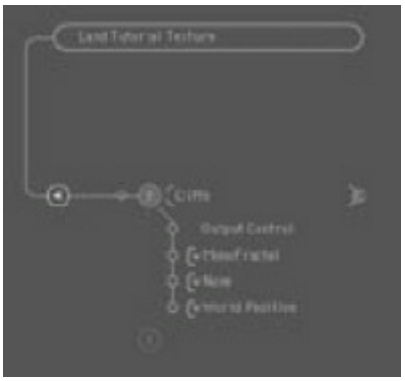
Between the Blend Control Button and the Texture Leaf Button is a small circle.

This is a leaf connection button. Switching it off and on detaches or re-attaches
a leaf to the Texture Tree. If a leaf is not attached to the tree it takes no part in
any blends and contributes nothing to the final texture. Disconnecting a texture leaf in
one Texture Tree disconnects that leaf from all trees in which it participates.

Land Texture Tutorial, part 1

Part one of this tutorial will create an exaggerated terrain of widely spaced mountains. It will introduce the Texture Leaf Kickstand and the Curve Editor. Start with File->New. Click the Circle-T Global Parameters Hot Button to open the Land Texture Editor. Choose “New Texture” from the Texture Editor Options Menu to begin editing a new texture. Be sure to change the texture's name to something more descriptive, such as “Land Tutorial Texture.”

First, we'll make a rough fractal to act as the cliffs. Click the first disconnected Circle-T node to create a new Texture Leaf. Click again to open the Kickstand. The default texture that gets created is a simple 3D texture, in the form of a simple fractal function driven by the coordinate system of the MojoWorld. You can see this in the kickstand, where World Position goes through an empty distortion node (more on distortions later), and is sent to a Monofractal, and then to the output control.



Before doing anything else, change the name from “Texture Leaf” to “Cliffs.” Making a habit of changing the names of these elements will prevent you from ending up with a dozen or more Texture Leaves all named “Texture Leaf.”
Once the Texture Leaf is named, select the Monofractal, and then over in the Control Stack on the right, change the Largest Feature parameter to 100,000.

Tip

Don't use commas when typing in your values. For example, 100,000 should be entered as 100000.

Why 100,000? Mountains can cover large areas and this value sets up peaks that are about 100Km (about 62 miles) apart. One upper limit to note, however, is that making the Largest Feature too much larger than the Radius of the MojoWorld planet will spend time calculating features that will never show, because they are larger than the planet itself!

The preview swatches will have noticeably change from a noisy, grainy texture to a smoother cloud-like texture. Note the altitude readout under the preview swatches.

The default is 100Km. The zoom level can dramatically affect the appearance of the texture.

Change the Basis Function parameter from “Value/Gradient Perlin” to “Ridged Gradient.” The preview swatches will change from a cloud-like texture to a ridged texture.

Even though we've changed two parameters of the Monofractal, the view of the planet in the RTR remains completely flat. This is because the output of the leaf is still below the resolution of the RTR preview. Another feature unique to the Land Texture Editor as compared to any other Texture Editor shows up underneath each of the preview thumbnails. These value readouts show the actual elevations of the Land Texture sampled in the preview. Looking at them now, they'll show the Min elevation is 0 meters and the Max elevation is 2 meters. With the 'peaks' of the mountains being 100 kilometers apart and only 2 meters tall, it's no surprise that the RTR is still flat.

To make the mountains visible, the output of the texture needs to be

increased. There are two ways to accomplish this. The first is through setting the Result Scale parameter on the Monofractal to a large value. The second involves using the Curve Editor, and while it may seem more complicated and take more time, you will have much finer control over the end result.

It's important to compare the two methods, so first start by setting the Result Scale parameter of the Monofractal to 10,000. (Why 10,000? Because mountains are tall and oceans are deep, and because MojoWorld units are in meters, a good range for Land Textures is -10,000 to 10,000. For comparison, Mount Everest is 8,848 meters tall and the Marianas Trench is 10,668 meters deep.) Look at the value readouts underneath the preview thumbnails and note that it now shows a Min close to -5350 and a Max close to 17,520.

That's significantly different from our expected -10,000 to 10,000 range. However, if you zoom out with the preview zoom tool to an altitude of 3200km, the Min/Max values shown much more closely approximates the expected range. This is what you'd expect if you were tasked with measuring the average altitude of the Earth and you only get to take 10 samples. The results you'll get will be different if you're measuring ten spots at random in the parking lot downtown versus ten spots at random from across all of Africa.

Set the Result Scale back to its default of 1.0. Click on the Output Control portion of the kickstand then click on the Input Curve icon in the Control Stack to open the Curve Editor.

See the Curve Editor

If you go back into the Curve Editor and set the 'Beyond Input' DDLB to 'Clamp' then all values output by the Monofractal that are smaller than the Min Input (currently set to 0.0) get re-mapped to 0. This creates perfectly flat basins. At the other end of the scale, all values output by the Monofractal that are larger than the Max Input (currently set to 1.0) get re-mapped to 10,000. This creates perfectly flat plateaus along the tops of the mountains.

Note that you may have to put your camera at an altitude of at least 100km to see these features in the RTR. Seeing the effect of the clamped curve can help you visualize how the output from the Monofractal that's between 0 and 1 is re-mapped by the curve into terrain altitudes between 0 and 10,000. These two renders show the terrain without the clamping behavior and with the clamping behavior.

Land Texture Unclamped

Land Texture Clamped

Set the 'Beyond Input' DDLB back to 'Continue' and in Part Two of this tutorial, the mountains will be truncated using a second Texture Leaf, creating more natural-looking rolling plateau tops. Don't forget to save your file again before continuing.

Working with the Curve Editor

The Curve Editor
The Curve Editor is one of the most powerful tools in creating and editing textures. Throughout this tutorial and the tutorials which follow, we'll give specific instructions on how to configure the various Curve Editor parameters to achieve the desired results. Don't worry about understanding it all right away as it can take quite some time to appreciate how the Curve Editor affects the data which define textures. We've designed this tutorial to help you gain that appreciation through observing specific Curve Editor configurations.

The mechanics of working with in the Curve Editor should be relatively intuitive with respect to creating, moving, and editing control points, specifying Min and Max Input and Output values, and setting various DDLB options. Refer to the Curve Editor Reference section at the back of this manual for a detailed study of the Curve Editor.

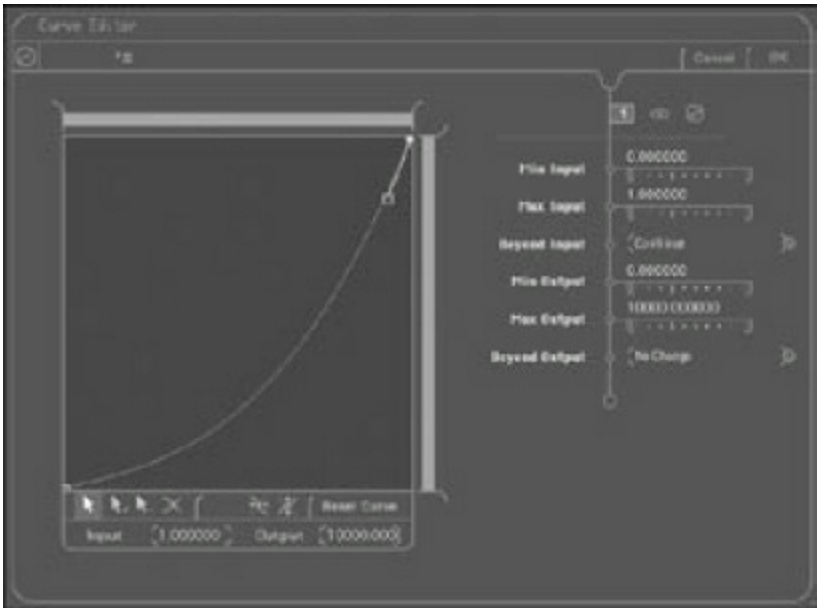
In the currently open Curve Editor, set the Max Output parameter to 10,000 and click OK in the upper right of the Curve Editor to accept the change. The Min and Max readouts under the preview swatches show the same ranges as when the Result Scale of the Monofractal was set to 10,000.

Before continuing, save your planet file. We will be working with this same planet file as we progress through all of the tutorials in this section.

> Two important things to keep in mind while working in the Curve Editor are, “what is the source of input?” and "how will the output be used?” We already know that the output will be used to create the mountains and valleys of the terrain. The question of, “what is the source of input?” depends on the context in which the Curve Editor is used. In this tutorial, the Curve Editor is part of our

Texture Leaf Kickstand. The flow of data goes up the kickstand, so the values this curve gets as its input are the values coming out of the Monofractal just below it on the kickstand. Very generally speaking, most fractals will generate output approximating a range of -1 to 1 before they are multiplied by their Result Scale values, though a lot can depend on the choice of Basis Function, the type of fractal and the settings of some of its other parameters, such as the Roughness.

Pop back into the Curve Editor for two quick changes. These changes involve manipulating the control handles on the two end points of the Curve. First, click the control point in the upper right corner of the Curve editing area. When the control handle appears, drag the handle downwards so that the angle it makes with the right-hand vertical edge of the editor area is approximately 20 degrees. Next, click the control point in the lower left corner of the Curve editing area. Drag its control handle downwards also, so that the angle it makes with the bottom edge of the editor area is also approximately 20 degrees. The curve will now have a markedly concave form. Click OK to dismiss the Curve Editor and observe the results in the RTR.



You'll notice that the mountain peaks have gotten taller and more exaggerated, while the valleys have become smoother and

shallower.

Return to the Land Texture Tutorial, part 1

Land Texture Tutorial Part Two

This tutorial carries on from Land Texture Tutorial Part One, which you should go through first. Part two will chop off the exaggerated mountains created in part one to create steep cliffs topped with gentle plains and will add some strange rocky out-crops here and there around the MojoWorld. It will introduce the Blend nodes on the Texture Tree, the Basis Function Editor and will revisit the Curve Editor.

Now we'll create the rolling plains which will truncate the tall mountains. Click the bottom Circle-T icon to create a new Texture Leaf. Expand the kickstand and change the name from “Texture Leaf” to “Rolling Plains.” Click the down arrow beside the Monofractal node, and change this to be a Heterofractal. Select the Heterofractal, and change the Largest Feature parameter to 200,000. We want to create rolling plains, so we'll adjust the Smallest Feature to smooth off the fractal. Note that if you have the Generator UI Mode preference set to 'Simple' the Smallest Feature parameter is hidden. Normally, MojoWorld keeps adding detail until it gets smaller than a single pixel. By using the Smallest feature size, we can adjust how small the features can get before MojoWorld stops adding detail. Set the smallest feature size to 10. This means that our rolling hills are approximately 200 kilometers between the largest hilltops, and about 10 meters between the smallest bumps on the terrain. Open the Curve Editor for this Texture Leaf. The input source is the Heterofractal with a Result Scale of 1, so set the Min Input to -1 to cover the full normal range of the fractal's output. The output from the curve will be combined with the first Texture Leaf to shape the terrain.
Set the Max Output to 10,000. Click OK to dismiss the Curve Editor.

The default blend node between these two Texture Leaves is Maximum, which means we'll get the tops of our exaggerated

mountains sticking out above the highest of the rolling plains. We want the opposite, so set the Blend mode to Minimum. This should create a landscape of steep cliffs topped with undulating plateaus where the rolling plains fractal goes below the exaggerated mountains fractal. Render a few images, and adjust the parameters of the fractals to make an interesting cliff-and-plateau landscape.

Next, we need to add the rocks to our landscape. We'll do this with Noise instead of a fractal because a simple noise has only one size of feature, and is suited to the smooth look that we want here. Click the third Circle-T node to create our new leaf and open its kickstand. Name this Texture Leaf “Rocks.” Click the down arrow beside the Monofractal, and change it to Noise. Set the Largest Feature parameter to 300 to make our rocks 300 meters across. Click the “Value/Gradient Perlin” basis function sub plug-in and change it to “Voronoi.” Click the sub plug-in editor to open the Basis Function Editor.

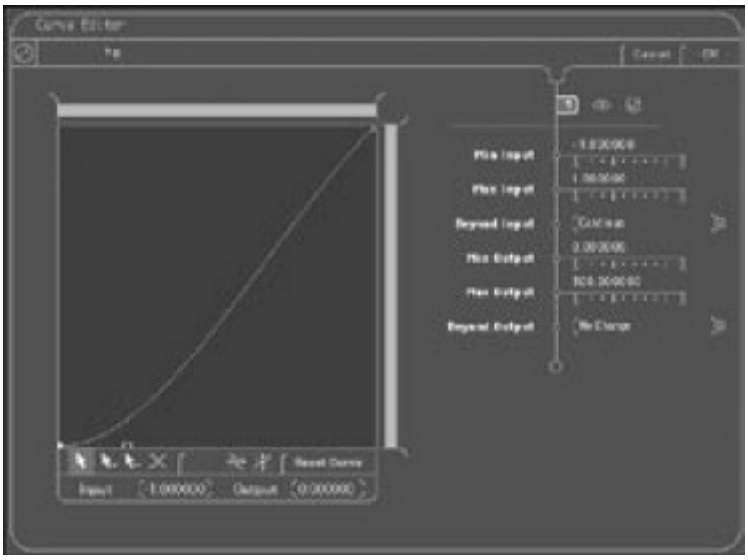
The Basis Function Editor

The Basis Function Editor is another very powerful element in defining textures. A
complete discussion of the Basis Function Editor and the various options associated
with each of the Basis Functions is covered in the Basis Functions Reference section
in the printed manual.

For this tutorial, set the Voronoi Basis Function's 'Neighbor Mode' DDLB to '1st & 2nd Closest' and then click OK to dismiss the Basis Function Editor.

Open the Curve Editor for this Texture Leaf. The input comes from the Voronoi noise, so change the Min Input to -1 to cover its full range.

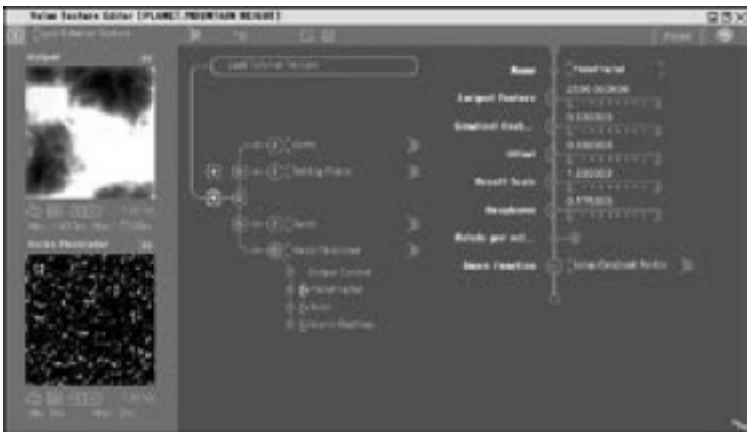
The output will be adding in the rocks, so change the Max Output to 300 to make the rocks approximately as tall as they are across. To ensure that the output of this Texture Leaf is always greater than 0 (which will make the rocks always poke above the existing terrain, rather than cut into it), move the control handle of the lower left control point to be flush with the bottom edge of the graph. Setting one or both of the end point control handles to be horizontal has a similar result as setting the Beyond Input DDLB to 'Clamp,' but because it can be done to just one end point, leaving the other one at an angle, it's a way to clamp only one end of the output. Click OK to close the Curve Editor.



Change the blend mode between this leaf and the one above it to an Add blend to add rocks to the terrain. However, they only show up on the tops of the plateaus. This is because the Terrain Texture evaluates the Rocks leaf and then adds in the Rolling Plains leaf, and then takes the minimum of that result and the output of the Cliffs leaf. This means that where the Cliffs leaf is less than the combination of the Rolling Plains plus the Rocks, the Rocks do not appear.

Click the lower Circle-T button to create the fourth and final leaf node. By adding a fourth Texture Leaf, we can accomplish two results. One is that we can force the rocks to appear in the valleys as well as on

the plateau tops. The other is that we can limit the areas where the rocks appear. When a fourth Texture Leaf is added, the additional Graph Layout buttons appear. Click the lower Graph Layout button to re-group the Texture Leaves. Now when the Terrain Texture is calculated, it takes the maximum of our new leaf (which is still a default texture leaf, outputting values in the -1 to 1 range) and of our Rocks leaf (which is outputting values in the 0 to 300 range), then adds that to the separately calculated minimum of the Cliffs and Rolling Plains leaves. The net effect is that there are Rocks added everywhere.

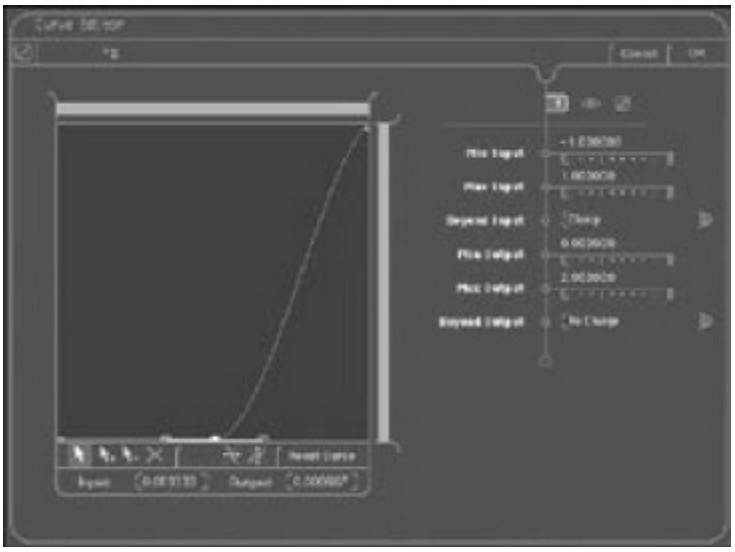


The final touch is to tweak this fourth leaf into a Rocks Modulator. First, change the texture leaf's name to "Rocks Modulator.” We use the name “Rocks Modulator” because it will modulate where the rocks appear. This texture should output zero over large parts of the terrain and in others it should output values near 1 or 2. When the two textures are multiplied together, where the Rocks Modulator is 0, the Rocks leaf will be likewise zeroed out, and where the Rocks Modulator is 1 or 2, the Rocks leaf will be amplified by one to two times its actual result.

In the Rocks Modulator Monofractal, change the Largest Feature parameter to 2,500 so the areas of the rock outcrops are larger than the individual rocks. Then select the Output Control. Because the input comes from a fractal with a Result Scale of 1.0,

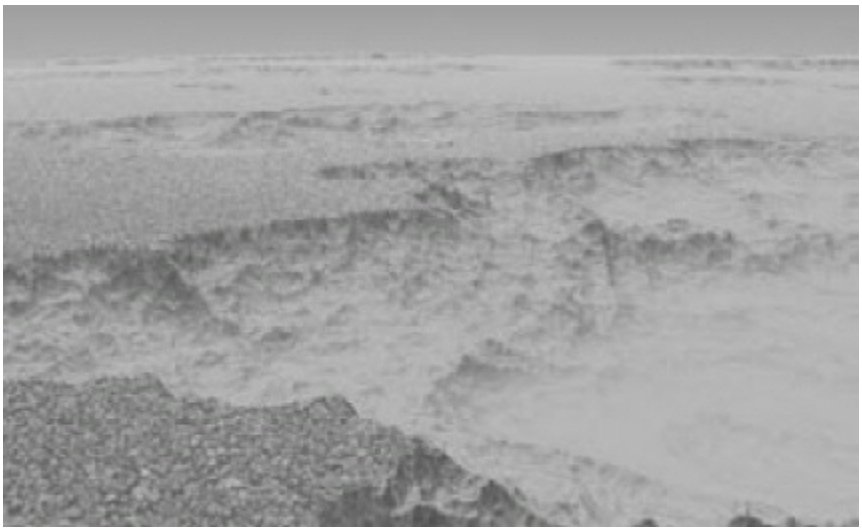
change the Min Input to be -1.0 so we cover the whole range. Change the Max Output to 2.0 so that the Rocks at the heart of each outcrop will be more exaggerated. Adjust the curve so it's flat at zero for about the first half of the curve, before rising to 2.0 for the second half.

Set the Beyond Input DDLB to “Clamp” and say OK to close the Curve Editor. In the lower preview in the Texture Editor, you'll see large areas of black with islands of white. The white areas are where the rock texture will show through and the black areas are where the rocks will be completely suppressed, because anything times 0 is 0.



Finally, change the blend mode between this leaf and the Rocks leaf above it to a Multiply. This will scale the rocks to zero over large parts of the planet, leaving them to poke through in patches.

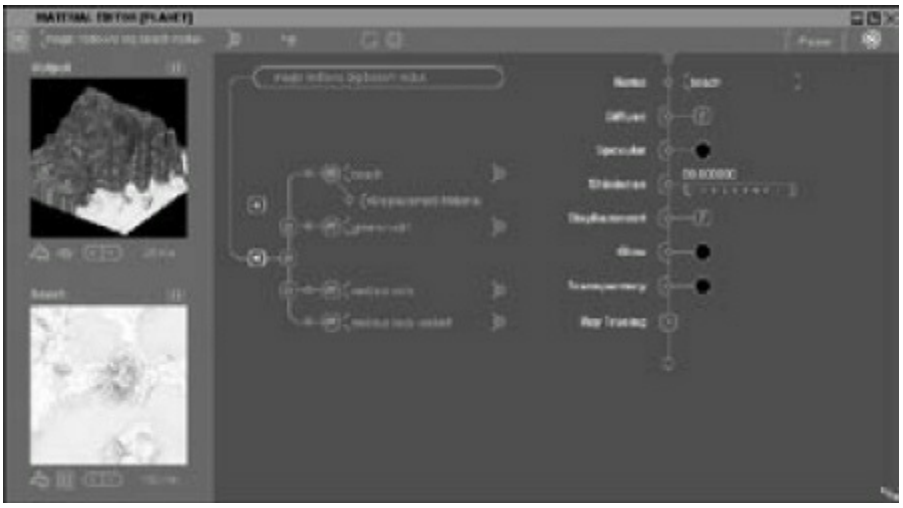
Now you have a MojoWorld of plateaus and cliffs, complete with rocky outcrops!



Material Editor

The Land Material Editor controls the surface properties of the terrain on your MojoWorld. In it are the controls affecting the way terrain surfaces react to light— things like color and shininess.

Access the Land Editor's associated Material Editor by clicking on the Land Material Editor hot button in the Global Parameters hot button bar.



The Material Editor Title Bar has the standard Stow, Maximize and Close buttons. Below that appears the Material Editor icon on the left, and beside that a DDLB (Drop-Down List Box) displaying the name of the material currently being edited. This DDLB lists the different materials that may be selected and edited. Next to the DDLB is an Options Menu for creating, cloning, deleting, or removing materials, and saving and loading materials to and from Materials Library files.

Material Editor Options Menu

New Material Opens a new Material Tree with the default name “New Material.” The Tree starts with a single Material Leaf.

Clone Material
Duplicates the currently selected material. The name of

the cloned material has a sequential number appended to the original name, starting with “01” if the original name
does not end in a number. The clone becomes the currently selected material.

Delete Material
This option deletes the currently selected material completely, and removes it
from all other objects to which it is assigned. The material will no longer be avail-
able in the Material Editor DDLB.

Remove Material
This option clears the currently selected material and removes it from the terrain
or object to which it is currently assigned. The material is still available in the
Material Editor DDLB.

Save to Library...
This option opens the Library Exporter associated with the Material Editor. Refer
to the Library section for a complete description of the Library Exporter dialogs.

Load from Library...
This option opens the Material Library Importer. Refer to the Library section for a
complete description of the Library Importer dialogs.

Tidy Up...
This option opens the Node Janitor. Use the Node Janitor to delete textures, texture
leaves, materials, material leaves and function nodes that are not currently used (they are
not contributing to the current MojoWorld scene at all).

Simply click on the Rubbish Bin
icon associated with the nodes you wish to delete. To clear all unused nodes, click on the top Rubbish Bin icon.

See the Material Type Properties Reference at the back of the printed manual for details on
the basic material types. See mojoworld.org for details on newer material types which
may be available as plug-ins.

Preview Swatches
The two Preview Windows on the left of the Material Editor display aspects of the material. The top Preview Window displays the final result for the entire Material Tree. The bottom Preview Window displays the appearance of the currently selected Material Leaf or Blend.

The preview swatch tools in the Material Editor work the same way as the preview swatch tools in the Texture Editor. Refer to the Texture Editor section earlier in this section for a description of the Preview Swatch tools.

See Adding a Leaf to the Material Tree

Adding a Leaf to the Material Tree

You add a leaf to the Material Tree by left clicking on the Material Leaf Button below, and not connected to, the Material Tree. Once selected, it becomes part of the tree and a new leaf appears. This new leaf can be edited as described above. You can add up to four leaves to a Material Tree. This works much the same way as adding leaves to a Texture Tree.

Material Leaf Buttons
To edit a Material Leaf, left click on the Material Leaf Button (Circle-M) beside the Leaf.
Left clicking on the fainter Material Leaf Button below creates a new leaf, if you have fewer than four leaves. The currently selected leaf has a red dot beside it.

If you right-click on a material leaf an option menu relating to that leaf appears; the choices on the menu are Clone, Remove, or Delete..

Clone will copy the current material leaf, leaving the original untouched. Remove will remove the material leaf from its position on the tree. Delete will remove the leaf from the tree as well as deleting it from the MojoWorld scene entirely (possibly affecting other materials which may be using it).

Clicking on the Material Leaf DDLB itself will list all currently defined material leaves in the MojoWorld scene. Materials are listed in the order they are created and are not sorted by type.

When adding a leaf to the tree, the default Blend between new

leaf and the existing tree is a 'Maximum' Blend. The other Blend types are similar to the Blends found in the Texture Editor.

Blending Leaves on the Material Tree

When you have two or more leaves on the Material Tree, a Blend Control Button appears where the leaves connect. Click on this Circle-B Button to edit the Blend Mode.
A DDLB appears with the following entries:

Average
Adds the colors of the leaves being blended, then halves the result to keep it from getting too light or pastel.

Add
Adds the colors of the leaves being blended. NOTE: This tends to create a result
that is very light or pastel, or even white. If this is happening, try Average instead.

Subtract
Subtracts the second leaf's color from the first. NOTE: This tends to create a
result that is very dark or even black. If this is happening, try Average instead.

Multiply
Multiplies the colors of the leaves being blended.

Minimum
Compares the colors of the two leaves and takes the minimum (darker) of the
two as the result.

Maximum
Compares the colors of the two leaves and takes the maximum (lighter) of the

two as the result.

Slope
Varies the blend based on the slope of the underlying terrain, using the Curve
Editor. The Curve Editor Icon appears under the Blend Control DDLB. An exam-
ple of a Slope blend will be covered in Material Editor Tutorial Part One.

Altitude
Varies the blend by the altitude of the terrain, using the Curve Editor. The Curve
Editor Icon appears under the Blend Control DDLB. An example of an Altitude
blend will be covered in Material Editor Tutorial Part One.

Blend
Uses a Texture Leaf to control the blend value. Refer to the Texture Editor sec-
tion of the manual for a complete description of a Texture Leaf. An example of a
Blend blend will be covered in Material Editor Tutorial Part Two.

Additional Controls on the Material Tree
A Material Tree can have a maximum of four leaves. When the Tree has four leaves, an
additional Graph Layout Button appears on the Tree. These additional graph layout
buttons work the same as the buttons in the Texture Editor.

When you click the Graph Layout Buttons the Material Tree changes shape. The Material Tree shape determines the way in which the four leaves are blended. Figure 1 displays the Material Tree when the top Graph Layout Button is selected. In this layout, the bottom two leaves are blended and the result is blended with the next leaf up. The result of this blend is blended with the top leaf. Figure 2 displays the Material

Tree if the bottom Graph Layout Button is selected. In this layout, the top two leaves and bottom two leaves are blended, and these two blends are blended.

Figure 1

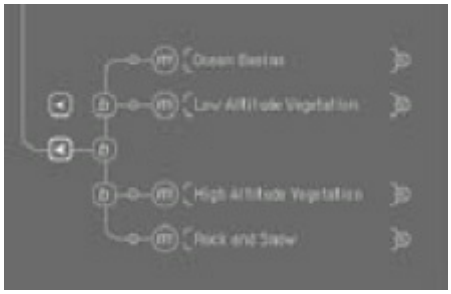


Figure 2

There is a small circle between the Blend Control Button and the Material Leaf. This is a Leaf Connection Button. Switching it off and on detaches or re-attaches a leaf to the Material Tree. If a Material Leaf is a part of more than one Material Tree, disconnecting it in one Material Tree also disconnects it in any other Material Trees which also use this Leaf.

See the Material Editor Tutorial, part 1

Material Editor Tutorial Part One

This tutorial carries on from the Land Texture Tutorials, which you should go through first.

The aim of this tutorial is to create a simple material to familiarize you with how the MojoWorld Material Editor is used. We will create a material with grass below a certain altitude, snow above, and rocks poking through wherever the terrain gets steep enough. Material Tutorial Part Two will show how to align a shiny crystalline texture with our rocky outcrops made in the Land Texture Tutorial Part Two. It will also introduce the Nested Material Tree material type.

Open your tutorial world saved from the Texture Editor tutorials. In the Global Parameters hot buttons, click the bottom Circle-M hot button to edit the MojoWorld material.

From the Material Editor Menu, select “New...” to give us a clean slate from which to start. This gives us a Material Tree with a single leaf containing a default displacement material. The default name of the Material Tree will be “New Material.” Change it to “My First Material” to make it easier to find when we get to understanding Nested Material Trees in Part Two of the Material Editor Tutorial.

First, we'll create the rock material that will show through whenever the slope is too steep to have either grass or snow on it. Click the Circle-M button beside the displacement material to bring up its Control Stack. Click on the Color Dot for the diffuse color, and make it a dark gray/brown to represent the rocks. Note that real rocks are more interesting, but we'll cover that in the color texture tutorials. Change the name at the top of the Control Stack to “Rocks” so we can find the material later on if we need it again. Also note that it's a good

idea to name Material Leaves when you create them, otherwise you end up with big lists of identical names like “Displacement Material,” which can become confusing.

This should make the entire MojoWorld turn our dark gray rock-color.

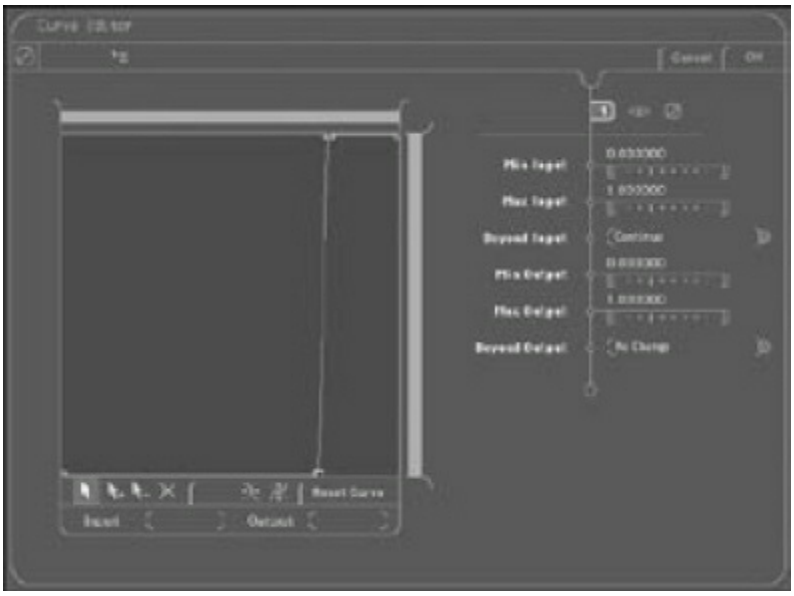
Now, we'll create another material to appear in places where the slope is too flat for rocks. Click the lowest Circle-M to add another material leaf to our tree. This also creates a blend node (the Circle-B that joins the two materials). Click the Circle-M again to bring up the new material's parameters in the Control Stack. We'll make this our grass material, so change the name at the top to “Grass,” click the Diffuse Color Dot and choose a medium green.

Now the whole MojoWorld should be a green color, probably close to the grass color you chose. This is because the default blend mode is “Maximum,” and chances are the grass color you chose was brighter than the rock color.

Now we'll define the blend based on slope that will make the rocks stand out on steep sections. Click the Circle-B blend node between the two materials, and from the blend type list choose “Slope.” A Curve Editor button appears under “Slope,” letting you change the way slope affects the blend. The default curve doesn't really match our needs, so click the Curve Editor button to launch the Curve Editor. In a slope blend, the slope is the input. A value of 1 indicates flat land, while a value of 0 indicates a vertical cliff. The output is a blend value, which is also 0 to 1. The default values for the various min and max inputs and outputs in the Curve Editor are exactly right for a slope blend. We want a sharp transition between the grass and the rock (to give the appearance of rocks poking through grass), so we'll need a curve that goes from 0 to 1 very quickly.

Select the control point on the lower left of the curve and make the slope through it lie flat across the bottom on the curve. Now do the same to the upper right control point, making the slope lie flat across the top of the curve. Then, using the “Add Point” tool, add two new points about three-quarters of the way across the graph.

Using the modify tool, drag the first new point you created to the bottom of the graph window. Drag the second new point to the top of the graph window. The second point should be slightly further to the right than the first. This makes the “step” of the function. Make the slopes of the control handles of both of these new points horizontal. Place one of the new points on the bottom edge near the center and the other new point on the upper edge to the right of the center. The exact position doesn't matter, but where these two new points lie determines the slope at which the rocks start to appear. How far apart they are determines how “fuzzy” the blend between the two materials is. Create a graph that looks something like this:

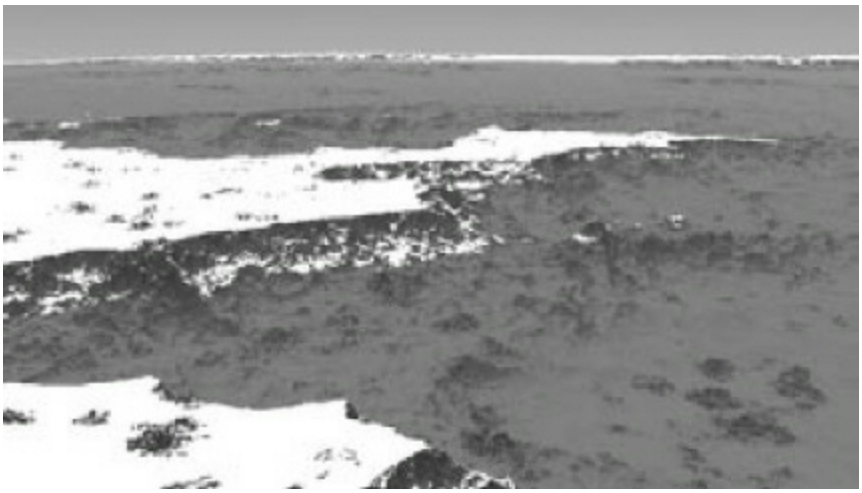


Looking at the MojoWorld (or the top preview in the Material Editor), you'll see the dark material of the rock poking through wherever the slope of the terrain gets steep, and the green grass wherever it's flatter.

Next, we need to create the snow material and set the blend between the grass and snow at a certain altitude. Click the lowest Circle-M node to create a third leaf node for our material. Click it again to show the parameters, name it “Snow” and set the Diffuse Color to white. Because snow is sometimes shiny, we may want a specular highlight.

You can set the brightness of the shiny specular highlight by setting the specular color to a suitable shade of gray. The lighter the shade, the brighter the highlight. (It defaults to black to keep the specular highlight at zero.) Finally, adjust
the shininess to whatever you think looks good. A value around 20 gives nice spread out highlights on the snow.

To create the blend between the grass and snow, click on the Circle-B blend node between those two materials. Change this from “Maximum” to “Altitude” to let us set the snow line. Again, this shows a curve button. Before opening the Curve Editor, use the Marker Flag tool to get altitude readouts of the planet in the RTR and use these altitude ranges to place your snow line. Open the curve editor. For altitude blends the input value is the elevation of the Land Texture. With the information gathered using the Marker Flag tool, set the Min Input and Max Input values to cover the range at which the snow line should appear. If you want to make the fade region of the snow very sharp, one strategy is to set the Min Input and Max Input values very closer together, i.e., the Min set to 5000 and the Max set to 5001, or set the Min and Max further apart (say 4500 and 5500, respectively) and then use the curve controls to make a sharper curve like we made for the slope curve. Either way, you should see a line across the terrain, with rocky snow above it, and rocky grass below. The actual altitudes you use will depend on the values you've gathered using the Marker Flag tool.



Selecting an altitude for the snow line that is on the mostly steep parts of the terrain can hide the fact that the transition from grass to snow is perfectly horizontal.

Now admire your work by rendering the current scene. After a test render, don't forget to save your MojoWorld because we will continue with it in the next tutorial.

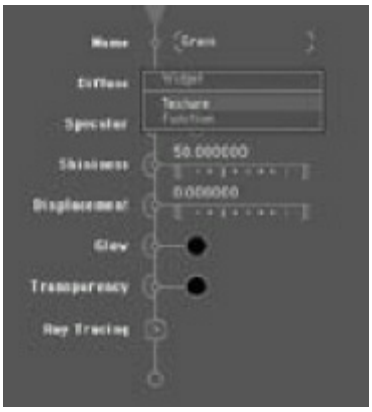
Color Texture Tutorial / Texture Blend Tutorial

This tutorial carries on from the Material tutorial, which you should go through first.

Picking up where we left off in the material tutorial, we can see some big problems with our MojoWorld. Snow lines are never perfectly straight, and rocks and grass are never one flat color (although snow usually is, which makes our life easier!)

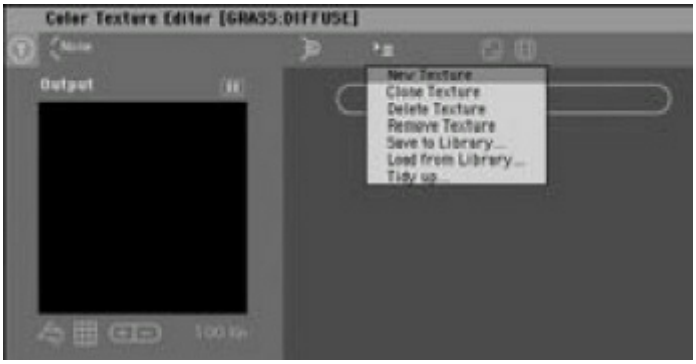
Let's add some textures now, to make our MojoWorld more interesting.

We'll start with the grass, and use a simple texture to mottle the appearance between light and dark green. Select the “Grass” material in the Material Editor and click the semicircle beside the color dot for the diffuse color. The semicircle indicates that a texture can be applied to this color. Clicking this opens a Color Texture Editor, and since initially there's no texture on the grass, it is empty.



Select “New Texture...” from the Texture Editor Options Menu to add a texture for the grass dif fuse color. Name this new texture, “Grass.” If you check back to the Material Editor, you'll see the Diffuse Color Dot has now changed to a Circle-T

indicating this is now controlled by a texture.

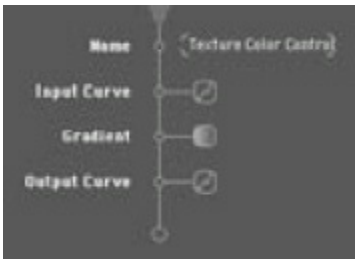


Back in the Texture Editor, these next steps will be a lot like our first Texture Tutorial where we created the texture to shape the land. Here we'll be defining a color texture instead of a value texture. Click the unconnected Circle-T button on the Texture Editor to make a new Texture Leaf, and click it again to open its kickstand. Name the Texture Leaf “Grass” as well.

Click the Output Control button to bring up its controls in the right hand Control Stack. Because this is a color texture, there are two additional controls here that were not present in the Output Control section when creating the land texture. The first item on the Output Control for a color texture is an Input Curve. This fulfills the same function as in a value texture. It can remap the data which comes out of the fractal node to a different range. The next is a Gradient. This is the source of color for a color texture. The third is an Output Curve where each of the R, G and B channels of the colors coming out of the Gradient can be re-mapped with an independent curve.

The first thing we'll do is adjust the Input Curve. The input is coming from a fractal node, so set the Min Input to -1.0. Click OK to close the Curve Editor and apply this change. The texture previews should show a grainy gray texture, and if you zoom in, you'll see the features of the fractal start to resolve. The default fractals have features about 1,000 meters (~3,000 feet) across, so zoom in to about that level to see the detail of the fractal. Grass isn't normally gray, so we'll use the gradient control to give a range of colors to our grass. Click the “Gradient”

button in the right hand Control Stack to open the Gradient Editor. Set the start and end colors to different shades of green, and add as many points as you like between them to add variations of color into the grass. The white and black areas of the fractal map to the two extremes of the gradient, and when you click “OK” you can see the result
of the gradient applied to both the texture and material previews, and on the MojoWorld itself.

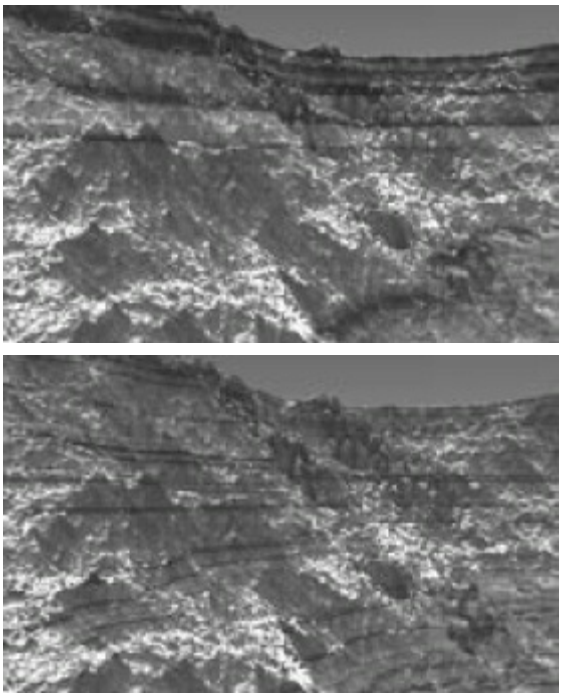


Now for the rocks. Many rocks form in a layered or stratified way, with different colored rocks layered on top of each other. We can do that easily in MojoWorld. Return to the Material Editor, and click the Circle-M button corresponding to the “Rock” material. Click the semicircle beside the diffuse color dot to open the Texture Editor. Again, this opens with no texture assigned, so select “New Texture...” from the menu. Name it “Rock Layers.” Click the first Circle-T button to create a new Texture leaf node, and click it a second time to open its kickstand. Name the texture leaf “Rock Layers” as well. This time we want to add a layered effect based on altitude, so the first thing is to drive our texture from altitude rather than the world position. Click the small down arrow beside World Position at the bottom, and choose Altitude from the list. In the preview windows, you'll see the fractal being mapped onto altitude, causing rings to appear at different levels on the terrain. Select Output Control, and as we did for the grass texture, change the curve Min Input to -1.0 to map onto the Monofractal that's creating the texture. Then open the Gradient Editor, and set the start and end colors to something appropriate for a layered rock. Try sandstone with differing browns and oranges, or something more like slate with dark blues and grays.

Minimize the editors you've got open, and wander around in the

RTR to find an interesting piece of rock, and render an image to see the stratification on the rocks.

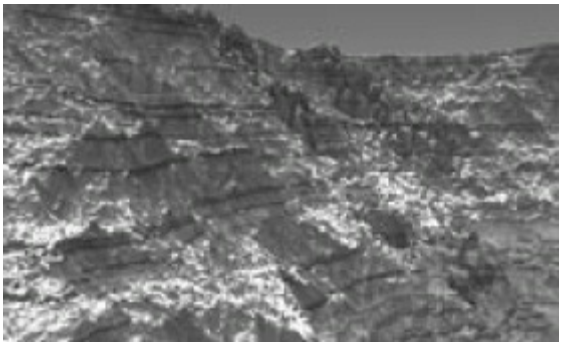
Depending on where you looked on the world, the stratification on the rocks may be either too large or too small. We can easily change that by changing the feature size on the fractal that creates those stratified features. In our first texture tutorial creating the land texture, we used the Largest Feature Size to adjust the approximate distance between the highest mountain peaks. Here in this color texture which we're driving with Altitude, the Largest Feature Size will adjust the thickness of the layers. These next two renders show the result of the Largest Feature Size at the default of 1000 meters and sized down to 100 meters.

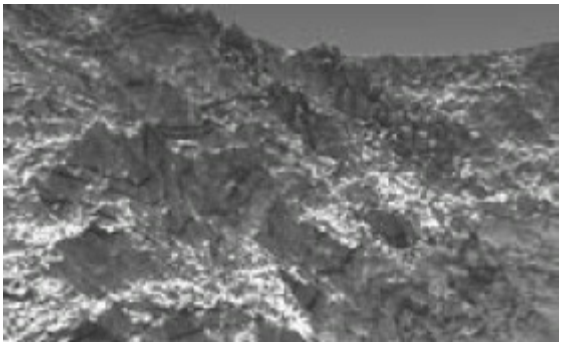


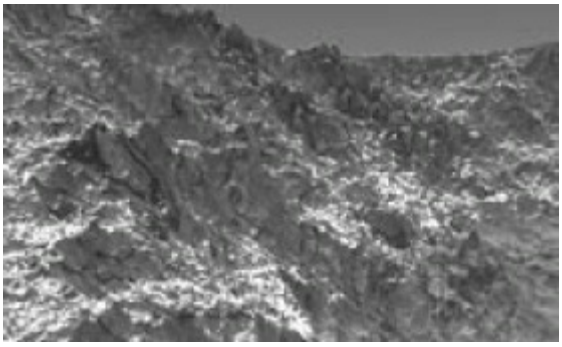
These rock strata are perfectly horizontal, which does not look very natural. We can use domain distortion to add some noise to these layers and make them much more interesting and natural. Domain Distortion takes the original point for your texture, whether it is World Position, Altitude or any of the other input coordinate spaces, and adds another texture to it before it gets used. The amount of distortion controls how much effect it has. It can range from apparently having no effect to completely chang-

ing the total look of the texture.

In the Rock Layers texture leaf kickstand, click the down arrow beside the “None” domain distortion node, and choose Monofractal as the distortion. Distortions always occur in World space, so we can set both the size of the largest distortion feature, and the maximum amount that it distorts the input. Set the Largest Feature of this Monofractal to 2,000, and set the Result Scale to 100 for a subtle distortion. Increase the Result Scale to 1000 for an extreme distortion. The following images show the Result Scale of the distortion at 100, 500 and 1000 respectively.







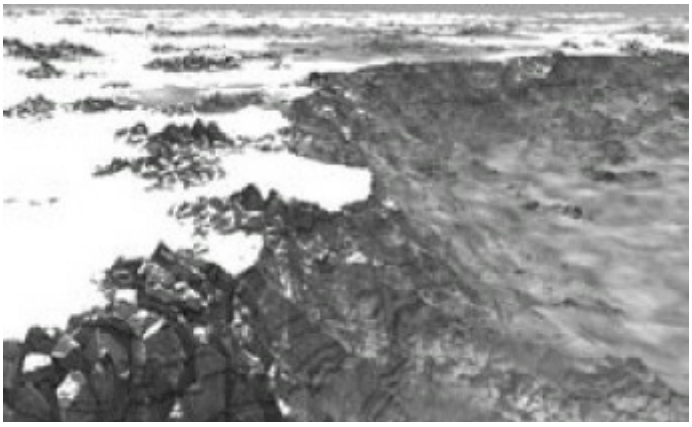
The Largest Feature Size of the Domain Distortion fractal adjusts the approximate distance between the highest points of the distortion ripples. The Result Scale of the Domain Distortion fractal adjusts the amplitude of the distortion ripples.

You can use the same technique of domain distortion to make the snowline more natural. Return to the Material Editor, and click the blend node between the grass and snow. To add domain distortion, we need to create a more complex blend, so click on the Altitude blend type, and change it to a “Blend” type. The “Blend” type is a very general blend mode that can use a whole texture leaf of its own to control the blending between two materials. Note that on the right side of the Material Editor, a single parameter showing the name “Texture Leaf” has appeared. This is where you can and should change the name of the Blend texture leaf to something more descriptive, such as “Snowline Blend.”

As with the rock layers, we want to control the blend by altitude, so change the Coordinate control at the bottom to Altitude by clicking the down arrow beside World Position, and choosing Altitude from the list. This time we don't want to use a fractal (as we know the altitude where we want things to happen), so we can turn the fractal off by clicking the down arrow beside the Monofractal, and choosing “None” from the fractal list. This means the blend is driven directly by altitude. Click on the Altitude node at the bottom of the kickstand to select it and note the parameters which appear on the right. The first is a checkbox labeled “Use Sea Level” When this box is checked, the Altitude inputs will be adjusted to be relative to the level of whatever Ocean may be present on our MojoWorld. Open the Curve Editor for the Input Curve of this Texture Leaf. For input, we'll have the same actual terrain altitudes determined with the Marker Flag tool for our original Altitude blend. The output will be a blend value, which should be 0 where we want the grass and 1 where we want the snow. Set the Min Input and Max Input values close to each other and both around the value of the altitude at which you

measured with the Marker Flag for placing the snow line. Leave the Min Output and Max Output as their default values of 0 and 1. This essentially duplicates our original Altitude blend, but with the important difference that it can be distorted.

Click the down arrow beside the “None” domain distortion node, and choose Monofractal as the distortion. Distortions always occur in World space, so we can set both the size of the largest distortion feature, and the maximum amount that it distorts the input. Set the Largest Feature of this Monofractal to 2,000, and set the Result Scale to 1000. In the RTR, find an interesting section of the terrain where the texture transitions from snow to grass, and render an image of that. You should see a much more complex line between the two materials, looking more like a natural snow line.



See the Material Editor Tutorial, part 2

Material Editor Tutorial, Part Two

This tutorial carries on from the Color Texture / Texture Blend tutorial, which you should go through first.

Aim: using a Nested Material Tree and a Texture Blend, apply a bright shiny material to the rocky outcrops we created in the Land Texture Tutorial Part Two. We'll also introduce the 'Surface Position' input coordinate.

Open your tutorial planet that you've been working on through the earlier Land Terrain Editor and Land Material Editor tutorials. Use the Land Material Hot Button to open up the Land Material Editor. Use the menu to create a new material. Change the material's name to “Material With Crystals.” Change the type of the first material leaf to a Nested Material Tree.

In the Control Stack on the right, use the Material DDLB to choose the material you created in the first Land Material Tutorial.

Click the ghosted circle-M to enable a second leaf. Click this second leaf again to open its Control Stack. Name the Material Leaf, “Crystals.” Set the Diffuse color dot to some bright electric blue or vibrant purple, or whatever dramatic color will stand out for our crystal outcrops. Set the Specular color dot to a slightly less bright color and set the Shininess to 20.0. For some extra fun, set the Glow parameter

to a deep rich red.

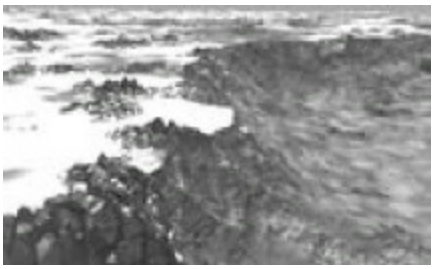
Now for the tricky part - creating the blend between these material leaves to make the shiny crystals material appear only where the Voronoi rock outcrops are added to the terrain. Fortunately, we already have the “Rocks Modulator”
texture leaf. And, better yet, the “Rocks Modulator” leaf already outputs a range that is 0 where the crystals do not occur and 'larger than 1' where the crystals appear. So, we can set the Blend type to 'blend' and use the DDLB at the top of the blend texture kickstand to choose the “Rocks Modulator” texture.

Find one of the crystal rocky outcrops and render -- and note that contrary to expectations, the crystal material does not perfectly line up with the rocky outcrops! This is because after the Land Texture (including the “Rocks Modulator” leaf) has been evaluated to determine the shape of the terrain, the “World Position” at which the color texture is given to evaluate the “Rocks Modulator” texture is no longer the same as before the Land Texture was first calculated.

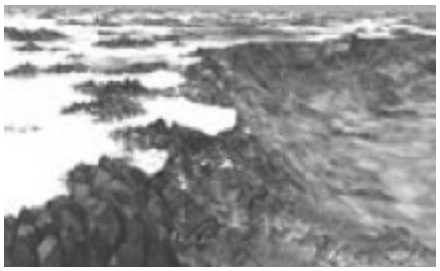
The way to fix this is to change the Input Coordinates of the “Rocks Modulator” texture leaf to “Surface Position.”

The Surface Position input coordinate forces the evaluation of the Rocks Modulator leaf in the color texture to use the exact same input as when the Rocks Modulator texture was evaluated as part of the Land Texture. The Land Texture and the Land Material share this “Rocks Modulator” Texture Leaf in our current planet file. Making changes to the Texture Leaf in one editor changes it in the

other, thus affecting the shape of the terrain and the coloring of the terrain from either editor.



Mis-aligned crystal material



Aligned crystal material

Tip

If the Land Texture and Land Material are exported to library files then loaded into the same new planet file, the “Rocks Modulator” leaf will then be two unique copies of the Texture Leaf and changes made in one editor will not be connected to the other.

The world now may be a bit overwhelming with outcrops of glowing purple crystals everywhere you look, so edit the Rocks Modulator to have a Largest Feature of 25,000 (just add a zero to the end), and in the Input Curve, slide the middle point to the right along the bottom edge of the graph, narrowing the peak on the right portion of the graph. This will make the outcrops of crystals a bit rarer and more of a special find when they are encountered.

Water Editor

The Water Editor is found in the Global Parameters hot buttons. It has a Title bar with the standard Stow, Maximize and Close buttons. Below that appears the Water Editor icon on the far left, a Menu button towards the middle, and the Pause and Jump buttons on the right.

The Water Editor icon is what the Water Editor looks like when it is stowed in the Editor Stow area.

If the current MojoWorld does not have an ocean, the parameter area of the Water Editor remains empty until you create one.

Water Editor Options Menu

The Water Editor Options Menu is where you can create a new ocean, delete the existing ocean, load a new ocean from the library, or save the existing ocean to the library.

Create Ocean

Creates an ocean on your MojoWorld. Ocean surface height defaults to halfway between the terrain height and the current camera height.

Delete Ocean

Deletes the ocean from your MojoWorld.

Save to Library
This option opens the Library Exporter associated with the Water Editor. Refer to the Library section for a complete description of the Library Exporter dialogs.

Load from Library
This option opens the Ocean Library Importer. Refer to the Library section for a complete description of the Library Importer dialogs.

Water Editor Control Stack

Name
You can edit the name of your ocean for identification in the Object List and as a saved object.

Sea Level
Sea level is the distance of the surface of the ocean from the MojoWorld radius.

You can only create one ocean.

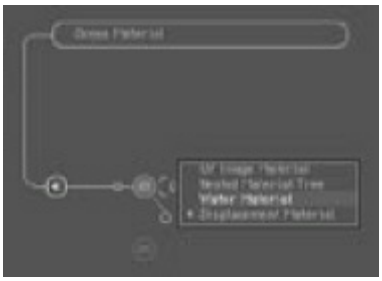
To apply a material to the Water object, use the Circle-M global parameter hot button immediately below the Water Editor hot button or alternatively the Material button on the Ocean Control Stack. Waves are created by applying a displacement to the water material. More details can be found in the Material Properties Reference section and the following tutorial.

Water Tutorial

Aim: create an Ocean primitive, set the Sea Level and create a basic water material for our ocean.

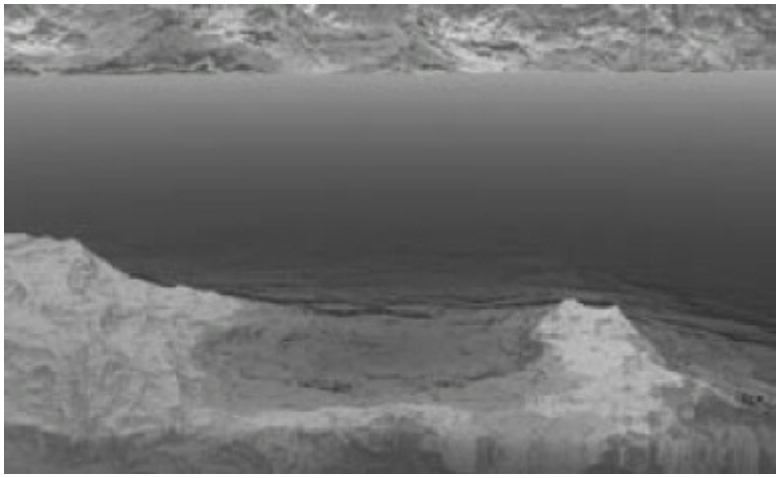
Open your tutorial planet that you've been working on through the earlier Land Texture Editor and Land Material Editor tutorials. From the Global Parameters, choose the Water Editor hot button (the water icon) to open the Water Editor. Use the Create Ocean menu item to add an ocean to the tutorial world. The ocean is created with a Sea Level half way between the altitude of the current camera and the ground immediately below it. At this point, you'll likely need to adjust the Sea Level dial to ensure that you have both water and land visible.

When the ocean is first created, it has no material on it at all. Click on either the Water Material Editor Global Parameters Hot Button, or on the Material icon in the Water Editor's Control Stack to open up a Material Editor for the material assigned to the Ocean primitive. Choose New Material from the menu. Change its name to “Ocean Material.” Click the Circle-M by the first material leaf, and from the mate-rial type list that pops up below it, change the type to “Water Material.”



We'll do two things to the default water material to make it more interesting: add some differing levels of murkiness, and add a displacement map to create waves. The first step is to get a feel for

the scale of the water. In the RTR it's very easy to lose that sense of scale, and end up looking at the ocean from 10km up wondering why you can't see any detail in it. Even in the clearest water, the maximum depth that light can penetrate is only a few hundred meters, so to see good detail in the water it's important to get the camera down close to the surface. Cruise around in the RTR and lower the camera so your altitude is only about 100m above sea level. Get a good view of a shoreline. Render an image from there to see how the default water material looks. Note that as the water gets deeper you see progressively less detail of the underlying terrain in your rendered image, and as your view angle gets flatter to the surface of the water, you see less of the terrain refracted in the water, and more of the sky reflected. You can change how these things behave, but the default values are a reasonably good simulation of real water.

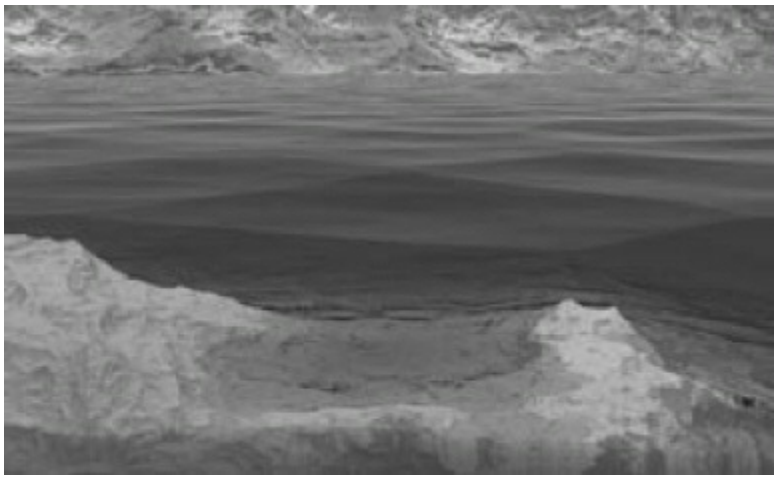


First let's add a displacement to get some interesting waves on the water. From the Material Editor, click the semicircle beside Displacement parameter and choose “Texture” to launch the Texture Editor. Create a new texture from the Texture Editor Options Menu. Name this texture “Ocean Waves.” Click the first Circle-T leaf node to add it, and click again to open its Control Stack. Name the Texture Leaf “Ocean Waves” as well. There are many ways to create convincing waves, so we'll just use one of them here. Click the Monofractal node, change the Largest Feature to 300.0 and the Result Scale to 5.0. This creates waves about 300 meters apart, and 5 meters high. These are pretty big waves, but in keeping with the grand

scale of the mountains
around them.

While the default basis function makes reasonable waves, using a ridged basis function produces something more like the actual shape that ocean waves can take. Try changing the basis function to a Voronoi, and lower the roughness of the Monofractal to about 0.15 to get reasonably convincing ocean waves. See the Basis Functions Reference at the back of this manual for more details about the Voronoi and other basis functions.

Next we'll add some texture into the murkiness of the water, to break up the totally clean look that the default water has. The Murkiness parameter controls a simulation of how much detritus is floating in the water. A value of 0.0 corresponds to clear distilled water, and values around 100 look more like muddy water. In the Material Editor, click on the semicircle beside the Murkiness parameter and again choose texture from the menu. In the new Texture Editor that opens, create a new texture and name it “Murkiness.” Enable its first Texture Leaf and name that leaf “Murkiness” as well.

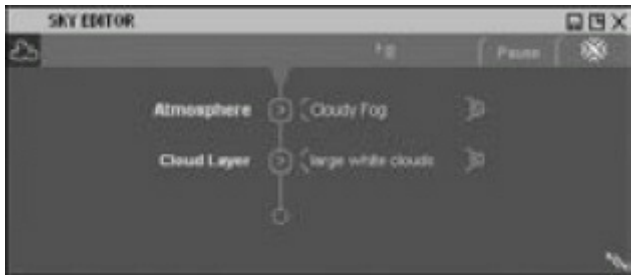


For this texture we don't need the fine detail of a fractal. We can use a simple noise; it's generally much quicker to render than a fractal, anyway. Change the Monofractal to a Noise, and set to Largest Feature Size to 2000.0 to create areas of murk about 2Km across. Then select the Output Control and in the Input Curve, set the Min

Input to
-1.0 to cover the range of the Basis Function. Change the Min Output to 1.0 (corresponding to very clear water), and the Max Output to 30.0, which is reasonably murky water. If you render an image of the water, you'll see some areas of clear blue water, and others of murky green/brown water. You can modify the shape of the Output Control curve on the Murkiness texture to change the relative amounts of clear and murky water.

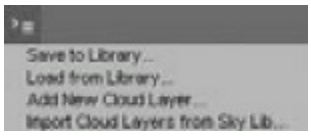
Sky Editor

The Sky Editor is found in the Global Parameters Hot Buttons. The Sky Editor allows you to control all atmospheric aspects of the MojoWorld sky. The Sky Editor window has a Title bar and the standard Stow, Maximize, and Close buttons. Below that appears the Sky Editor icon on the far left, a Menu button towards the middle and the
Pause and Jump buttons on the right.



Sky Editor Icon
When the Sky Editor is minimized in the Editor Stow, it is represented by the Sky Editor icon.

Sky Editor Options Menu
Use the option menu to save or load a Sky preset, create new cloud layers, and to steal cloud layers out
of other Sky presets.



Save to Library
Saves the sky (Atmosphere and all Cloud Layers) to disk. Refer to the Library section for a complete description of the Library Exporter dialogs.

Load from Library
Loads a sky (Atmosphere and all Cloud Layers) from disk. This overwrites any Atmosphere or Cloud Layers you currently have on the Control Stack. Refer to the Library section for a complete description of the Library Importer dialogs.

Add New Cloud Layer
This adds a new cloud layer Control Stack in the parameter area. This new cloud layer may be renamed and modified like any other cloud layer, as described below.

Import Cloud Layers from Sky Lib
This option opens the Sky Library and allows you to add the cloud layers from other files into the current Control Stack. This option does not overwrite any Cloud Layer you already have on the current Control Stack, nor does it change the Atmosphere.

Sky Editor Control Stack
The parameter area contains the Sky Editor Control Stack. In a new planet, this Control Stack will have a single entry relating to the Atmosphere. Any defined Cloud Layers will also show up on this Control Stack.

Atmosphere
There are several choices for possible Atmosphere types. The default is Cloudy Atmosphere and that is the one we'll use in the tutorial below. Any Atmosphere other than 'None' will have a Control Stack Expand widget to access additional parameters. For details on some of the other Atmosphere types, see the Atmosphere Reference. Additional Atmosphere types will be made available as plug-ins.

Sky Tutorial

Aim: To create some high cirrus clouds.

Open your tutorial world or start with a new world file. Click the Sky Editor icon in the Global Parameters Hot Buttons to open the Sky Editor. From the Sky Editor menu, choose “Add new cloud layer.” This creates a new layer at the bottom of the Control Stack.

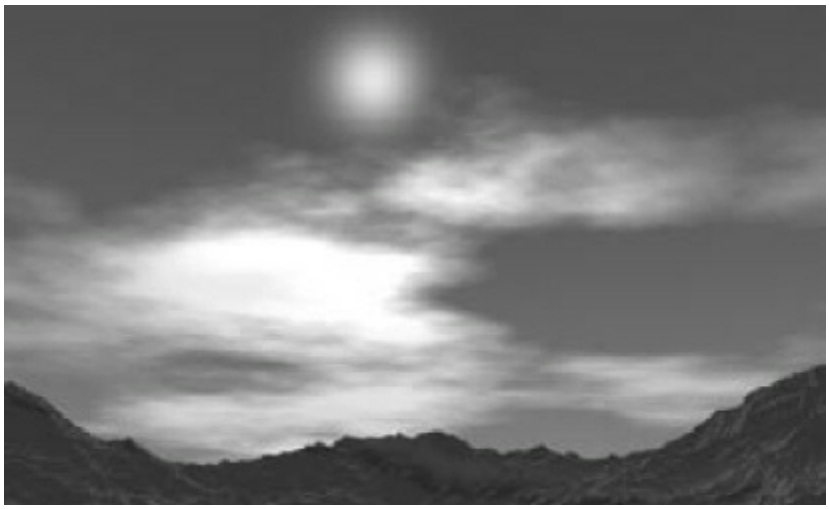
Click on the “None” and select “Cloud Layer”. Currently there's only one type of cloud layer available, but as new plugins get released for different cloud types, they'll appear on this list as well.

Click the Control Stack Expand widget to access the parameters of the new Cloud Layer. The first thing we'll do is give the cloud layer a name, “Tutorial Clouds.” If you look up into the sky in the RTR and render an image now, you'll see a flat white sky. This is because the default clouds have a constant density of 1.0 everywhere and thus obscure everything.

To make realistic clouds, we'll drive the density parameter of the cloud layer with a texture. Click the semicircle beside the Cloud Density parameter, and select Texture

to open a Value Texture Editor and make a new texture. Set the new texture's name to “Tutorial Clouds Density.” Click the first Circle-T node in the Texture Editor to make a Texture Leaf. Expand the kickstand and change the name of this leaf to “Cloud Density.” The default scale of a texture is too small for good clouds, so select the Mono-fractal, and change the largest feature size to about 60,000. While normally we'd go into the Input Curve and set the Min Input to -1.0 in order to cover the whole range of the fractal, it works to our advantage to just use the raw fractal output. Anywhere the output is 0 or less, there will be no clouds.

If the sun is in the picture, you'll see that near the sun the cloud edges are brighter from the scattered sunlight.



High altitude stratus clouds tend to get swept around by the winds there, and don't generally look like the puffy cumulus clouds you often see at lower altitudes. We can get that kind of effect in our clouds by using domain distortion on the fractal. Domain distortion involves taking the input coordinates and adding another texture to them before passing them to the fractal function. The result of this is to smear out some places and scrunch up others.

Click the down arrow on the distortion control (where it's currently saying “None”), and select Noise for our distortion. You can

distort with either simple noise or a fractal.
Using Noise yields smoother, less complicated distortions, whereas fractal distortions tend to be much busier and more jumbled up. For our clouds, we want the smooth distortions that a noise provides. On the new Noise node Control Stack adjust the parameters so the Largest Feature and Result Scale are both 200,000. The result from this noise is added to the world position, so by making it bigger than largest feature of the primary fractal, we'll make sure that the original shapes of the clouds are completely distorted. There will be some parts of the sky that look similar to the original clouds, some parts that look like much finer clouds, and some parts where the clouds are swept out over huge areas of the sky. If you play with different Basis Function sub plug-ins and their parameters (if any), you can get the clouds to do some really weird and wonderful things.

Moon Editor

The Moon Editor is found in the Global Parameters Hot Buttons. The Moon Editor allows you to create and edit not only Moons, but also Planetary Rings. The Moon Editor has a Title bar with the standard Stow, Maximize and Close buttons. Below that appears the Moon Editor icon on the far left, a Menu button towards the middle, and the Pause and Jump buttons on the right.

Moon Editor Icon
When the Moon Editor is minimized in the Editor Stow, it is represented by the Moon Editor icon.

When you open the Moon Editor the parameter area displays a Control Stack and a scaled slider called the Moon Bar that displays relative distances of the moon(s) and/or ring(s) from the MojoWorld. Click the various items on the Moon Bar to select from the moon(s) and/or ring(s). As each item is selected, its individual Control Stack appears below.

A planetary ring is represented by a pair of icons. These icons may resemble a cross when placed close together. You may drag the halves of this cross independently to alter the inner or outer radius of the ring. You may alter the entire ring at once by

dragging on the rectangular area between the icons. The currently selected moon or ring is highlighted in red and the Control Stack extends to connect to the selected object.

Moon Editor Options Menu

Use the option menu to add a new moon, add a new ring, delete the current object, save the current object to the Satellites library, load a moon from the library, and load a ring from the library.

Add Moon

This option adds a new moon. The new moon appears in the RTR at a default position in front of the camera. Only a moon object is created - in order for the moon to render, it must also have an associated Render Object. See the Moon tutorial below for further information.

Add Ring

This option adds a new ring. Planetary rings are always in the plane of the equator.

Delete Current Object

If the current object is a planetary ring, you will be prompted to confirm if you are sure that you want to delete the ring. If the current object is a moon, you will be prompted to confirm if you want to delete not only the moon object, but also any render object and / or light source that may be associated with that moon.

Save to Library

This option opens the Library Exporter dialog in order to save the currently selected object to disk. The home folder for this Library Exporter is the Satellites sub-folder of the Libraries folder. Refer to the Library section for a complete description

of the Library Exporter dialogs.

Load Moon from Library
This option opens the Library Importer dialog and shows only moon objects. Refer to the Library section for a complete description of the Library Importer dialogs.

Load Ring from Library
This option opens the Library Importer dialog and shows only ring objects. Refer
to the Library section for a complete description of the Library Importer dialogs.

Moon Editor Control Stack
Name
Edit the name of each moon to distinguish it from the others in the Object List.

Orbit Radius
The orbit radius is measured from the center of the MojoWorld. This value is
automatically updated as you move the selected moon on the slider. Values can
also be entered directly from your keyboard.

Moon Scale
Defines the scaling factor of a moon. The moon render object is scaled up by this
amount.

Orbit Position
Moves the moon around in its orbit. This control is independent of the time con-
trols in the Time Editor. If MojoMove is present, the Orbit Position parameter can
be converted to a Time Graph in order to create moonrise / moonset animation

effects.

Render Object
When enabled, this parameter allows the moon to be rendered as an object.
It also allows you to select an object to be a moon. All currently loaded primi-
tives are available to choose in the Moon Render Object DDLB. The suggested
method is to create a new primitive to use for the Moon Render Object, then
select the primitive you just created in the Moon Render Object DDLB. The
object becomes the Moon, is scaled by the Moon Scale parameter, and is moved
out to the Moon position.

Light Source
Lets you select any of the existing lights to serve as moonlight, or to delete a
moonlight source. The selected light source is placed at the moon position and
directed towards the MojoWorld.

To alter the path of a moon across the sky, drag on the wireframe moon in the RTR Window with the Pick Tool.

Planetary Ring Control Stack

Name
Edit the name of each ring to distinguish it from others in the Object List.

Inner Ring Radius
This parameter sets the distance between the center of the planet and the inner edge of the ring. The value is clamped at 0, though suggested ranges begin at a value larger than the planet's radius.

Outer Ring Radius
This parameter sets the distance between the center of the planet and the outer edge of the ring. The value is clamped to 10 meters larger than the Inner Ring
Radius value.

Material
This opens the Material Editor for the material applied to the Planetary Ring
object.

The Planetary Rings can only ever be in the equatorial plane. There can be more than one Rings object, however.

See the Moon Tutorial

Moon Tutorial

Aim: to create a moon and put it in orbit.

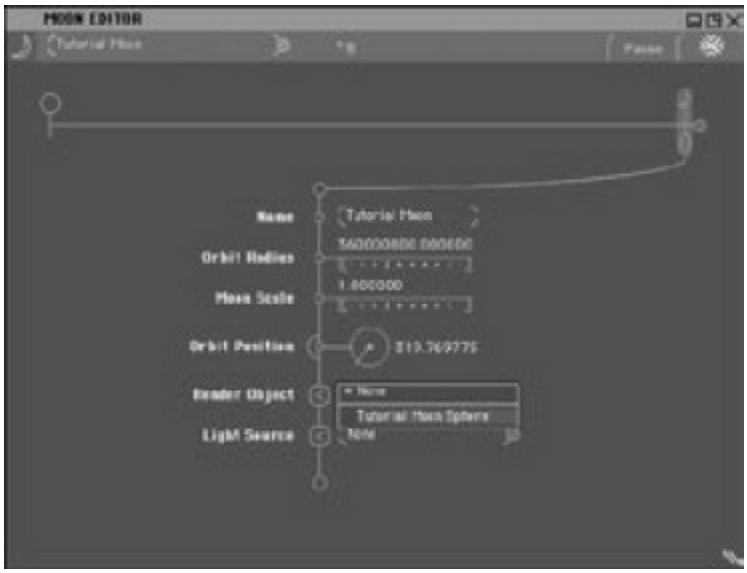
To create a new moon, open the Moon Editor and select “Add Moon” from the Moon Editor Options Menu. This creates a new moon orbiting the MojoWorld. By default, the orbit path of a newly created moon is placed directly in front of the camera. Give your moon a unique name to identify it in the Object List.

Next we'll create a sphere to serve as the moon's render object. Click the Sphere icon in the Create Palette and then click in the RTR to place the sphere. It doesn't matter where it is, or how big it is, as our moon controller is going to handle all that for us.

Click the Sphere hot button to open the Primitive Editor for the sphere, and set its radius to 1.0. It'll get so small in the RTR that it seems to disappear, but don't worry.
Once the moon controller is in charge, we can make it as big as we need. Give this sphere a unique name to identify it in the Object List.

In the Moon Editor, select our newly created sphere in the Render Object DDLB on the Control Stack.

In the RTR the sphere seems to disappear, but that's because the moon controller has grabbed it and placed it in orbit around the MojoWorld. Now we need to scale it up. Enter a value of about 5,000,000 in the Moon Scale parameter. This is quite a bit bigger than Earth's moon and is in fact nearly as large as our MojoWorld planet! [As an aside, the default moon's orbital distance is the same as that from Earth to our moon. However the Earth's moon is only 1,738km in radius.]



The new moon should now be visible in the RTR on the orbital path in front of the camera. The moon may look “too small” in the RTR. Some strategies for making the moon appear larger include using a narrower Field of View on your camera, or moving the moon closer to the planet. You can change the distance at which the new moon orbits either by changing the Orbit Radius value in the Moon Editor or by dragging the icon of the moon in the Moon Bar above the Control Stack. The MojoWorld is at the far left of the slider, and the furthest moon is at the far right. To expand out the range of the slider, click the small “>” button at the very far right. This rescales the moon bar and lets you place moons on orbits further out. Note that when changing the orbital radius of a moon that the default MojoWorld is 6 million meters in radius, so anything less than that has your moon orbiting inside the MojoWorld!

An alternate way to size the moon sphere is to create a sphere, set its radius to 5,000,000 in the Primitive Editor and leave the moon scale at 1.0 in the Moon Editor. Either way works. Do both, and your moon will be too big! The specifics of whether the scaling is handled by the Moon Scale parameter or by the size of the Moon Render Object will affect how the material applied to the Moon Render Object needs to be scaled.

If you open the Time Editor, you can make your moon orbit the MojoWorld as you change the Time of Day and Time of Year dials. If you want the orbit of the moon to lie in another plane, choose the Pick Tool and drag on the moon sphere. This lets you move the orbital plane around in the sky. To change the original position of the moon in its orbit, you can use the Orbit Position dial on this moon's Control Stack in Moon Editor.
This acts as an offset to the position that the Time Editor sets, letting you set the moon at pretty much any position in the sky at a given time.

The sphere we used as our Moon Render Object is probably still selected, so you can click the Circle-M hot button on the hot buttons bar to open the Material Editor and create a moon-like material. If the sphere isn't selected, open the Object List and click on its entry. This brings up the hot buttons and let you access its Material Editor.

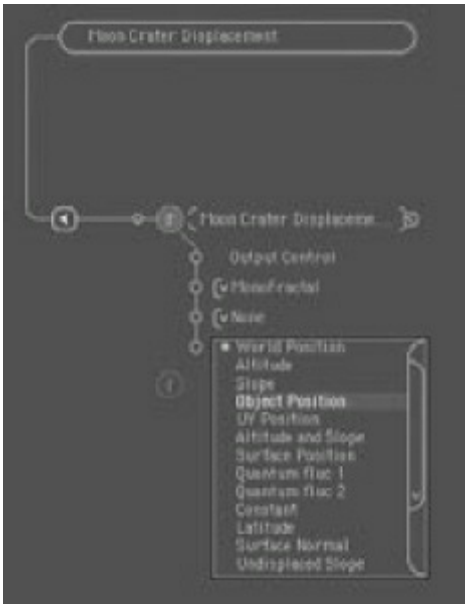
A good moonlike material can be made with a displacement texture on top of a diffuse white surface. Create a new material and name it “Moon Material.” Don't forget to also name the first Material Leaf to “Moon Material” as well. Using the default displacement material, set the Diffuse color dot to white. A render of the moon now is a shaded but otherwise featureless sphere.

The main effect of the moon material will come from driving the Displacement parameter with a texture. Click the semi-circle next to the Displacement parameter to assign a texture. In the texture editor which opens, create a new texture, enable the first leaf, and name both the texture and the leaf “Moon Crater Displacement.”

Many of the preset moons have textures that are defined in Object Position input coordinates instead of World Position. The reason is

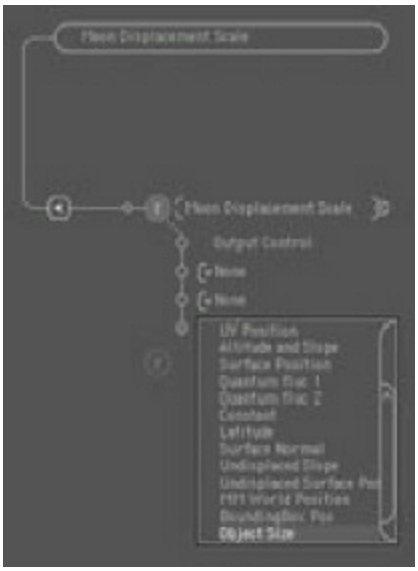
because if you animate a moon with its textures defined in World Position, the moon
will appear to move through the texture as it moves along its orbit.

At the base of the texture leaf's kick-stand, set the Input Coordinate to “Object Position.”



Defining the textures in Object Position allow them to move with the object, but they also need to be scaled to the object. Most moons use a 1 meter radius sphere for their Render Objects. Scaling textures to a 1 meter sphere means that the Largest Feature parameter of any noise or fractal on textures applied to such a moon should be 1.0 or less. Just as in the first Terrain Texture Tutorial where we noted that the Largest Feature parameter of the Terrain Texture should not be too much larger than the Radius of the MojoWorld, the Largest Feature parameter of a Moon texture in Object Position coordinates should not be too much larger than the Radius of the Render Object. Set the Largest Feature parameter of the Monofractal to 0.7.

Change the Basis Function to Voronoi, which has a variant particularly suited to making a cratered surface. Open the Basis Function Editor and choose 'Parabolic' off of the Voronoi Type DDLB and then close the Basis Function Editor.



Remember that after the Moon Scale is taken into account, the moon is 5,000km in radius, so in order for the displacements to be visible they'll need to be quite large. There's a way to construct the moon displacements so that even after the moon is scaled, the displacements are still proportional to the moon object. Change the Result Scale to a texture and in the Texture Editor which opens, create a new texture, enable the first texture leaf, and change the names of both the texture leaf and the main texture to “Moon Displacement Scale.” Set the fractal to “None” as the purpose of this texture leaf is to output a constant value based on the moon's size. This is done by setting the Input Coordinates to “Object Size.”

Using the raw size of the object is going to be too large, however. To

scale it down, use the Input Curve. By setting the Max Input to 20 and leaving the Max Output set to 1, the result will be a value that is 1/20th of the value coming from the Object Size node.A render of the moon now is a significantly displaced and cratered lump.

You needn't restrict yourself to spheres for the moon. Any primitive or imported mesh can be used as the moon object. Use low orbit values to have space stations and satellites orbiting the MojoWorld, or be brave and fill half the sky with an interlocked chain of toroidal (donut-shaped) moons.

Sun Editor

The Sun Editor is opened in the Global Parameters Hot Buttons. The Sun Editor has
a Title bar with the standard Stow, Maximize and Close buttons. Below that appears
the Sun Editor icon on the far left, a Menu button towards the middle, and the Pause
and Jump buttons on the right.

The Sun Editor icon identifies the Sun Editor in the Editor Stow area of the main Generator UI.

Sun Editor Options Menu

Save to Library...

This option opens the Library Exporter associated with the Suns Library, and allows you to save the current Sun to disk. Refer to the Library section for a complete description of the Library Exporter dialogs.

The Sun Editor icon identifies the Sun Editor in the Editor Stow area of the main Generator UI.

Sun Editor Options MenuSave to Library...

This option opens the Library Exporter associated with the Suns Library, and allows you to save the current Sun to disk. Refer to the Library section for a complete description of the Library Exporter dialogs.Load from Library...This option opens the Library Importer associated with the Suns Library, and allows you to load a previously saved Sun. The new Sun overwrites your current Sun. Refer to the Library section for a complete description of the Library Importer dialogs.

When you open the Sun Editor the parameter area displays a Control Stack that is very similar to that in the Moon Editor. However, only one Sun can be created. The Control Stack relates to this sun.

Sun Editor Control Stack

Name
The name field may be edited.

Orbit Radius
The orbit radius is measured from the center of the MojoWorld to the center of the Sun.

Sun Scale
Defines the scaling factor of the Sun. The actual size of your Sun will depend on the size of your Sun Render Object.

Orbit Position
This dial moves the sun along its orbit independently of the Time Editor's Time of Day control. If MojoMove is present, the Orbit Position parameter can be converted to a Time Graph in order to create sunrise / sunset animation effects.

Render Object
When enabled, this parameter allows the Sun to be rendered as an object. It also allows you to select an object to be the Sun. All currently loaded primitives are available to choose in the Sun Render Object DDLB. The suggested method is to create a new primitive to use for the Sun Render Object, then select the primitive you just created in the Sun Render Object DDLB. The object becomes the Sun, is scaled by the Sun Scale parameter, and is moved out to the Sun position.

Just as with moons, you needn't restrict yourself to spheres for the sun. Any primitive or imported mesh can be used as the sun's Render Object.

Light Source

You may disable the Sun as a light source or select any of the available lights to serve as the Sun. Any light selected is moved to the Sun position and is directed at the MojoWorld. The default light is a directional light well suited to behave like sunlight. It's not really necessary to replace the light source of the Sun. Editing the light source of the Sun to change the color and intensity of the sunlight are powerful ways to create unique suns.

Light Editor (for Sunlight) Sunlight has both color and direction. In MojoWorld the Sun position and Time Controls change the direction, and you can modify the Color and the Intensity in the Light Editor.

Color
A Color Dot allows you to select the color of the light source.

Intensity
Controls the intensity of the light radiating from the light source. Total light is equal to the color multiplied by the intensity.

Sunset Colors
If this option is checked, the color of the sunlight changes dependent on the camera's location relative to the sun. The colors change to simulate sunset or sunrise, with the actual color of the light shifting towards red when the sun is low on the horizon.

Shadows
The Shadows Control Stack has parameters which affect the shadows created by the sunlight.

Shadow Bias
Controls how far the shadows are "lifted away" from objects to avoid problems with objects shadowing themselves. In most situations, the default value will work well, but you might encounter two conditions which can be fixed by altering the bias. If the shadows appear "detached" from the objects, with light leaking under the edges of objects, lowering the bias will pull

those shadows closer and alleviate the problem. If the shading of objects gets a banded appearance in places where there should not be shadows, the object is shadowing itself, and raising the bias will solve the problem.

Map Resolution
The shadows are generated as bitmaps, and this allows you to control the size of those images. Higher resolutions give sharper shadow edges, but it takes longer to render the shadow maps and uses more memory. Lower resolutions are faster to render, but give much softer edged shadows.

Filter Radius
Defines how big a region of the shadow map the renderer looks at when it determines how much shadow is at a given point. Larger Filter Radius values soften the edges of shadows, and smaller values give harder edged shadows.

If the filter radius is too low, the individual pixels of the shadow map appear, and the quality of the shadow edges suffers. To alter the path of the Sun across the sky, drag on the Sun in the RTR Window with the Manipulation Tool.

Tip

Moving the Sun with the Manipulation Tool will not work unless the Sun
has an associated Render Object. It can also help to temporarily set the
Sun Scale larger when moving the Sun in this way.

Most interesting sun effects come from changing the Sunlight color and from various parameters of the Atmosphere. In order for a Sun render object to show up in renders, the one requirement is that the material have a non-black Glow parameter. Few suns use displacements, but for those which do, they should use the same proportional displacement scaling as

described in the Moon Tutorial.

Stars Editor

The Stars Editor is found in the Global Parameters Hot Buttons. The Stars Editor has a Title bar with the standard Stow, Maximize and Close buttons. Below that appears the Stars Editor icon on the far left, a Menu button towards the middle, and the Pause and Jump buttons on the right. The Stars Editor icon identifies the Stars Editor in the Editor Stow area of the main Generator UI.

Stars Editor Options Menu

> *Save to Library...* This option opens the Library Exporter associated with the Starfields Library, and allows you to save the current Starfield to disk. Refer to the Library section for a complete description of the Library Exporter dialogs.
>
> *Load from Library...*
> This option opens the Library Importer associated with the Starfields Library, and allows you to load a previously saved Starfield. The new Starfield overwrites your current Starfield. Refer to the Library section for a complete description of the Library Importer dialogs.

Stars Editor Control StackThe options available on the Stars Editor Control Stack will depend on the setting of the Background Type DDLB. The two choices are None and Simple Sky.

> *Background Type*
> In this DDLB you may select a Simple Sky, or you may also choose not to have a sky at all. When additional Starfield plug-ins are available, they will appear in the Background Type DDLB.
>
> *Name*
> The Simple Sky has a Name parameter which you can use to identify the background

object.

Sky Color
The Simple Sky has a Sky Color parameter. You can apply a texture to the sky color to create stars and other effects.

Check the Starfields Library for examples of how to make stars and nebulae using the Color Texture Editor.

Parameter Bombs

All the editors described above have affected your MojoWorld on a global scale. Parameter bombs allow you control things in a localized area. Parameter Bombs can affect terrain, water or clouds. Imagine a solitary red mountain standing in a range of rocky and snowy peaks, or a meteor impact crater on a desert plain — Parameter Bombs make it easy to create such things, especially using the new Import Wizard under the File menu. Parameter Bombs can affect any material or texture applied to the land, water or clouds.

There are two selection tools for defining the area of a Parameter Bomb. These were introduced in the overview section. Now that you have worked through the earlier tutorials, you'll be able to manipulate these selection tools to get some really interesting results.

The two selection tools, the Square Marquee and the Circle Marquee, appear in the Selection section of the Create Palette in the Generator Interface Window. They are used to select a pyramidal or conical volume of the MojoWorld within which you can specify alternate parameters defining the land, ocean, and/or cloud layers.

When you select one of these tools the cursor turns into a disk. Position the disk on the MojoWorld's surface in the RTR at the center of where you want the effect to take place, then drag outwards to expand the selection to the desired size. For the Circle Marquee, drag direction does not matter. For the Square Marquee, the direction of the drag orients the edges and corners of the square that intersect the surface.

After the selection area has been dragged out the hot buttons look similar to the hot buttons for the global parameters, without the celestial objects and the fact that the top-most icon looks like the icon for the Square or Circle Marquee. This topmost

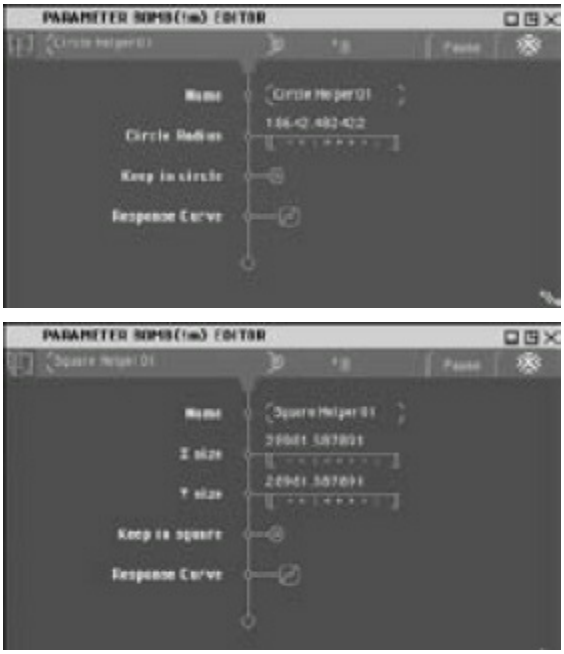
icon opens the Parameter Bomb Editor for the selection helper object where it can be named and resized.

The hot buttons below the one that opens the Parameter Bomb Editor are the same as those used for the global parameters. Their editors work in much the same way they do when you make global changes, but the changes they make are limited to the confines of the selection area. The Terrain and Water hot buttons are disabled and are there to provide context for the Water Material, Land Texture and Land Material hot buttons.

See the Parameter Bomb Editor

Parameter Bomb Editor

There are two different styles of Parameter Bomb in MojoWorld, the circle marquee and the square marquee. Each of these has a different Control Stack in the Parameter Bomb Editor. The River Terrain and MojoTree Parameter Bombs are highly specialized and each has its own section in the Advanced Topics section at the back of this manual.



There are two different Control Stacks in the Parameter Bomb Editor. Which one you use depends on the marquee you use.

Parameter Bomb Editor Options Menu

Clone

Duplicates the currently selected Parameter Bomb parameters. The name of the cloned Parameter Bomb has a sequential number appended to the original name. The clone becomes the currently selected Parameter Bomb.

Delete

This selection deletes the currently selected Parameter Bomb and removes the helper from the terrain.

Export Terrain...
Opens the Export Terrain editor. This feature is useful for exporting terrain data
for use in other applications.

Export Terrain Editor Control Stack

Filename
Displays the name of the file to which the height values of the terrain inside the parameter bomb is exported. File formats supported are: PNG, PGM, DEM, OBJ, VRML, DXF, 3DS, Lightwave, BT and Terragen.

Sample Resolution
These parameters indicate the number of samples on each of the x-axis and y-axis of the terrain to be exported. The maximum number of samples is determined by the file-type selected in the Filename field.

File-Format Options
Depending on the file format selected in the Filename field, the File-Format Options DDLB may display additional file format related options.

Preserve Aspect Ratio
When this option is checked the resolution is constrained so that the samples in the exported terrain corresponds to the square area of the planet. If, for example, you have a parameter bomb twice as wide as it is deep, this option will constrain the x resolution to be twice the y resolution. If this option is off, any resolution height map can be exported, regardless of the size and shape of the parameter bomb.

Write Texture File
When this option is checked, an additional part of the Control Stack is revealed which allows you to save the current material inside the parameter bomb as a texture map.

Texture Name File
Displays the name of the texture map file. File formats supported are: PNG, BMP, JPEG, Targa and TIFF.

Texture File Resolution
These parameters indicate the number of samples on each of the x-axis and y-axis of the terrain to be exported.

Import Terrain...
This editor automates the process of importing terrain and texture map data into a MojoWorld parameter bomb.

Import Terrain Editor Control Stack

Import Terrain
Check this option to import heightfield data.

Terrain File Name
Use the 'Load from Disk' icon at the end of the filename parameter field to browse for the terrain data file to import. Terrain data may be in the form of a greyscale image or a terrain data file.

Import Texture
Check this option to import bitmap color data.

Texture File Name
Use the 'Load from Disk' icon at the end of the filename parameter field to browse for the color bitmap data file.

Parameter Bomb Control Stacks
The following parameters are those that appear in either the circle or the square Parameter Bomb Editors.

Name
Allows you to edit the name of the Parameter Bomb. This is useful for identification if you are using several different Parameter Bombs.

X size
This Thumb Wheel controls the width of the patch of terrain described by the Square Marquee.

Y size
This Thumb Wheel controls the length of the patch of terrain described by the Square Marquee.

Circle Radius
This Thumb Wheel controls the radius of the circle described by the Circle Marquee.

Keep in square/circle
When disabled, this checkbox applies the parameters described by the Parameter Bomb to the entire MojoWorld.

Response Curve
This opens the Curve Editor that controls how much the Parameter Bomb influences the objects inside the selection. The default response curve is a straight line sloping at 45 degrees. With this curve, the center of the selection uses only the local parameters, while at the edges of the selection the original parameters are used. Halfway in, there is an equal blending of the inside and outside parameters.

Hyperspace Mixer Editor

One of the main points of exploring and creating in MojoWorld is to share your discoveries with others. Pandromeda distributes MojoWorld Viewer for free so that everyone (with a suitable computer) can share our discoveries in this parallel universe called Parametric Hyperspace. We've designed the Viewer so that even a child can get a sense of the richness of this parallel universe. They do so primarily by playing with the sliders in the Hyperspace Mixer.

The Hyperspace Mixer editor in the Generator UI is simply a copy of the Hyperspace Mixer from the Viewer interface, complete with randomizer dice. It has a similar appearance to the other Generator Editors. The sliders in the Hyperspace Mixer in the Viewer Interface are programmable by you, in MojoGraph. Some simple Hyperspace Mixers, such as a Sea Level slider, can be created in the Generator by loading pre-defined sliders from the Library. The Hyperspace Mixer tutorial in this section does exactly that.

For a more comprehensive tutorial on how Hyperspace Mixers are created in the Pro UI, see the tutorials in the Pro UI section.

Simple Hyperspace Mixer Tutorial

Aim: Load a Sea Level Hyperspace Mixer onto an existing ocean.Open the tutorial world we've been working with, or any other planet that does not yet have a Hyperspace Mixer for the Sea Level. First, make a note of the name of the material applied to your current ocean. Next, open the Water Editor and choose 'Load Ocean From Library' from the Water Editor Options Menu. If it is displayed, click on the Home Icon to go to the Oceans Library home folder. Within the Oceans Library home folder, there is a sub-folder called "Mixers." This contains pre-saved Ocean primitives with no material applied to the ocean, but with Hyperspace Mixers already pre-defined. Each of the pre-defined mixer oceans has a text description of the depth ranges covered by that mixer. For example, the MixerStandard.mjl has a slider defined to set the Sea Level between -10,000 and 10,0000.

Once an ocean with a pre-defined Sea Level mixer has been chosen, we need to set the material to the one that was on the old ocean. Open the Water Material Editor.
Note that it's currently set to no material at all. Use the DDLB in the upper left corner of the editor to choose the material applied to your previous ocean.

That's it - you now have a Sea Level Hyperspace Mixer that users of the free Viewer application can use to change the Sea Level in your planet! Again, for a more detailed tutorial on how Hyperspace Mixers are made in the Function Graph Editor, refer to the MojoGraph section.

Rendering

In MojoWorld, there are three ways to view the MojoWorld: with the Real-Time Renderer (RTR), with the Preview Renderer, or the Photorealistic Renderer. The RTR is designed for interactive exploration. It is always real-time, and it is always drawing the world as fast as it can. Because it has to be real-time and is based on the OpenGL standard supported in hardware by your graphics accelerator card, it can only render an approximation to what the final MojoWorld will look like. (Real-time rendering methods currently have to be much simpler than non real-time methods, that's just the current state of computer graphics.) However, if you stop exploring and give the RTR more time to work, its approximation gets better and better, and it ends up showing a fairly accurate view of the MojoWorld. There are some things that the RTR can't show, however, such as atmospheric effects, clouds, and the really fine detail that make MojoWorlds so fascinating. (That's largely because these effects are not supported in the OpenGL standard, to date.)

The Preview Renderer has an always-on mode which uses a multi-pass rendering technique to quickly resolve the general appearance of the current view. The Preview Renderer controls are discussed in the Introduction section of this chapter.

To see the full range of effects and realism that MojoWorld can conjure up, we use the Photorealistic Renderer. This is a lot slower than the RTR; it's not even close to being real time (at least in part because it is evaluating some of the most advanced models in the history of computer graphics to make its images). However, the Photorealistic Renderer can capture every detail the MojoWorld, down to the size of a single pixel in the image — or even smaller, if you want. The different Render Settings for the Pho-torealistic Renderer tell it how much detail to generate and render. As you increase these settings, the renderer takes longer to create the image. This is

because it examines the MojoWorld ever closer, modeling and imaging every nook and cranny, and capturing every detail in the textures. For large pictures of complex MojoWorlds, this rendering can take a long time compared to the RTR. By using the Uplink Queue, you can get MojoWorld to do that work while you catch up on your sleep.

Rendering the Current Scene

There are two ways to render a photo-realistic image of the scene displayed in the RTR Window.

1. Click on the Camera icon in the Render Utility Tools of the Generator Interface. If you render an image with this option you should select the Render Settings before beginning the rendering.

2. Select the “Process Later…” option from the Render Settings Menu in the Render Utility Tools of the Generator Interface. This second option does not render the image immediately, but instead sends the job to the Uplink Queue to be processed later. Render Settings can be changed in the Uplink Queue.

Rendering a Movie

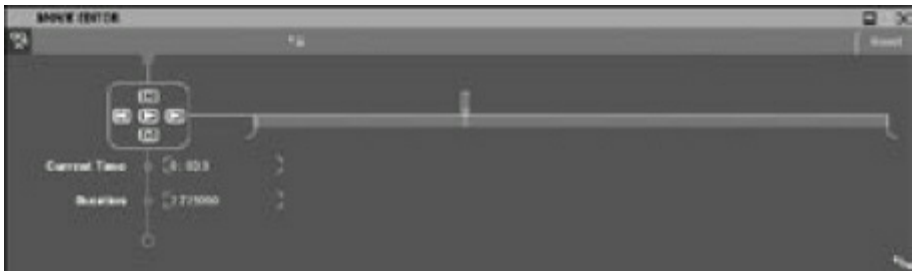
To render a movie, send it first to the Uplink Queue, by selecting “Process Later…” from the Movie Editor Options Menu. The following sections on the Movie Editor and the Uplink Queue describe the process for rendering a movie in detail.

Movie Editor

You access the Movie Editor through the Editors Menu on the Menu Bar.

The Movie Editor allows you to record the path of the camera in Walk, Fly, or UFO Modes. The basic controls are the same as in the Viewer Interface. If you have read the Movie section in the Viewer section and gone through the tutorial there, the controls in the Movie Editor should look familiar. In that case, you can launch right in and make some movies. If you have not read the section on the Movie panel in the Viewer section, you should refer to it for descriptions of the basic controls.

In the parameter area of the Movie Editor there are five buttons corresponding to Stop, Play, Record, Go to End of Movie, and Return to Start of Movie.



The Movie Editor opens with a Timeline exactly like the one in the Viewer Interface. It does not become active until you have

recorded a movie. Once you have, you can drag the slider to any point in the movie. You can also trim off the beginning and end of the movie to remove unwanted sections. The Control Stack displays the current time and the duration of the movie. The Movie Editor's timeline is independent of the Global Time in the MojoMove editor. Recording a Movie to be queued and rendered starts the Movie timeline at zero, but starts the Global Time at whatever value is cur-rently set on the Global Time dial. See the MojoMove section in the printed manual for more details.

The Current Time, displayed in minutes and seconds, shows you the position in time of the slider as it moves back and forth.

Duration refers to the length of the movie. This parameter may be edited. Changing the Duration parameter controls the speed of the movie. If you record a 3 minute long flight around the mountains, then reduce the Duration to 1 minute to make the playback speed three times as fast. This is particularly useful if you really want to make your flying look smooth, because you can record slow control movements and then speed them up for the rendered animation.

You can start and stop recording a movie without opening the Movie Editor by using the 'r' and 't' keys. When you stop the recording, the Movie Editor opens.

Movie Editor Options Menu
These options allow you add movies to the Log and the Uplink Queue.

Add to Log…
Saves the current movie to the Log Editor. When you add a movie to the Log, the Log Editor opens automatically.

Process Later…
This sends your current movie to the Uplink Queue for batch

rendering.

Log Editor

The Log Editor is travelogue where you can record the places you've visited and the movies you've made during your travels through MojoWorlds. When you select a log entry, a thumbnail is displayed next to the entry. That thumbnail is taken from the scene displayed in the RTR Window when the log entry was made. When a still image entry is selected, clicking on the Jump button takes you there. When a movie entry is selected, not only is the RTR window updated to that location, but the movie is also loaded into the Movie Editor timeline.

If the selection is a movie, a small timeline and three movie controls appear underneath the thumbnail. You can replay, fast forward and rewind the movie with these controls. Also displayed under these movie controls are the camera coordinates of the thumbnail. When you replay a movie in the Log Editor, it is shown in the RTR Window of the Generator Interface. It is wise to keep the close relationship between the RTR Window, Log Editor and Movie Editor in mind when you use these editors.

When the list in the Log Editor is long, you can scroll through it using the slider tab on the side. You can delete and duplicate entries in the Log using the buttons under the list. To render a movie in the Log Editor, you must select it, return to the Movie Editor and add it to the Uplink Queue by selecting “Process Later...” from the Movie Editor Options Menu.

Uplink Queue

Since each frame in a movie has to be rendered to make an animation, long movies can take quite a while to render – especially if the render quality is high. This is one reason MojoWorld includes a batch renderer: the Uplink Queue. It is basically a queue for renders to be processed after you've left off for the day. Both still image renders and
movies can be included in the Uplink Queue.

Still images, or high quality renderings of the scene in the RTR Window, are added to the Uplink Queue by selecting the 'Process Later…' option from the Render Settings Menu on the Render Utility Tools in the Main Generator Interface. The Uplink Queue opens automatically when this option is selected, displaying the queue with the new
entry highlighted.

Still images can also be added to the Uplink Queue from the RandomCam tool. When the RandomCam tool contains one or more saved thumbnails, clicking on the Satellite Dish icon in the

bottom thumbnail slot will automatically send all the RandomCam thumbnails to the Uplink Queue. See the RandomCam section in part one of this section for more information on queueing jobs from the RandomCam tool.

Note that large still image renders which have Tiling parameters defined in their render setting can only be rendered in tiled form when processed in the Uplink Queue. See the Render Settings section earlier in this section for more information on Tiled render settings.

Movies are added from the Movie Editor Options Menu. The Uplink Queue automatically opens when this option is selected, displaying the queue with the new movie entry highlighted.

You can edit the name of the movie or image in the queue simply by selecting the name and typing over the selection. Note that if you save a movie to the Log Editor and rename it there, open it again in the Movie Editor, then send it to the Uplink Queue, the new name does not survive. The movie has to be named again in the Uplink Queue. Images in the Uplink Queue have the extension .png by default. Other available formats are also BMP, JPEG, TGA, and TIFF. Movies in the Uplink Queue are given the extension .mov; this is the only available movie format at present. However, if you give a movie a image file extension name the renderer create a numbered sequence of still renders corresponding to the number of frames in the movie.

Tip

Serious animators will always choose to output their movies as a sequence of still frames, as this allows the most flexibility for post-processing, and distributing movie rendering across multiple machines. A third-party
application will be needed to assemble those frames into a final movie.

Entries in the Uplink Queue can also be identified by their thumbnails,

which appear on the left side of the parameter area. Clicking the Jump button above the thumbnail initiates a Hyperspace Jump in the RTR Window, taking you to the place seen in the thumbnail. To open the Uplink Queue from the Generator Interface simply select the Uplink Queue option in the File menu of the Menu Bar

The Render Room button in the top right corner of the Uplink Queue opens the Render Room – the place where the actual rendering occurs. Click this button when you are ready to render.

The Uplink Queue Control Stack
The Control Stack in the Uplink Queue remains collapsed when there are no jobs in the queue. When there are jobs in the queue the top half of the parameter area displays the list of the images and movies to be processed. Images are identified by a Camera icon and movies by a Movie Camera icon. If the queue contains more items
than can be seen in the list, use the slider tab to the right of the parameter area to move up and down the list.

The Process Checkbox
The space between the vertical line of the Control Stack and the camera icon is called the Process Checkbox. If an 'x' appears here the job is rendered when the queue is sent to the Render Room. If that space is blank the job is not be processed in the next rendering session, but remains in the Uplink Queue. (Such jobs can be enabled again
in the Render Room, if desired.) If there is a '-' in the Process Check Box, the job has already been processed. Processed jobs remain in the Uplink Queue in case you want to duplicate them and render them again with different Render Settings.

Cubic VR
In the space between the filename and the Save to File icon is a column where you can turn a still image into a QTVR panorama. For movie entries, there will be a dash in this column. To change a still image render into a QTVR panorama render, click in this column to make an 'x' appear. The filename will change to have a .mov extension.

This will cause the still image to be rendered as a Cubic QTVR movie instead. If the filename is re-set to a still image format before the queue is processed, this will cause the Cubic QTVR to be rendered out to six sequentially numbered frames.

Save to File
To the right of an Uplink Queue item's name is a Save to File icon. Use this to select a destination filename and folder for selected queue items.

Delete
Use the Delete icon to delete the selected Queue job. There is no confirmation on the Delete, so use it with caution!

Duplicate
Use the Duplicate icon to duplicate the selected Queue job. Once a Queue job has been processed, the only way to process it again is to first duplicate it.

Render Settings
The Render Settings for an image may be entered or modified in the Render Settings section of the Uplink Queue Control Stack. The default is the setting that was active when the log entry was made, but they can be changed here. Click on the Render Settings expander to see the options for the rendering. Using the Render Setting Dropdown List Box you can choose from a previously defined set of Render settings. Available settings include Low, Medium, Normal, High and Maximum (plus any custom settings you may have defined in the Render Settings Dialog).

Render Settings Control Stack
The options in the Render Control Stack in the Uplink Queue are the same as the Render Settings Control Stack in the Render Settings Editor dialog.

Render Room
The Render Room can be accessed via the Render button in the

Uplink Queue or from the File Menu in the Generator Interface. When the Render Room opens all MojoWorld windows other than the Render Room close. You may return to the Generator Interface by selecting “Go To Generator” in the File Menu of the Render Room Menu Bar.

Render Room Menu Bar

Go To Generator
Closes the Render Room and returns to the Generator Interface.

Uplink Queue
Opens the Uplink Queue.

Quit
This option exits MojoWorld without returning to the Generator Interface. If you
quit MojoWorld while you're in the Render Room, upon restarting, you'll be back
in the Generator UI.

The Render Room is largely taken up by the Render Preview Window. This displays the rendering as it progresses. Below the Render Preview area is a Message line where messages from the renderer are displayed. These messages include those seen in the Viewer and a Ready status displayed when the Render Room is not currently rendering. For detailed explanations of the text that appears in this area, refer to the section on the Render Status Bar in the Viewer section.

Render, Skip, and Stop

The Render, Skip and Stop buttons on the right control rendering. Start the queue with Render. Skip stops the current job and continues with the next. The Stop option stops the Render Queue. When a job is skipped or stopped, the render is written out to the specified file in its current unfinished state.

A duplicate of the Uplink Queue is displayed below the toolbar. This

shows the jobs queued for rendering. Jobs in this queue can be enabled and disabled using the Queued checkbox beside each job's name.

Render Setting Summary
The parameters in the Render Setting summary relate to the Rendering currently being processed. These parameters are for reference purposes only and may not be changed. Open the Uplink Queue if you wish to edit these settings.

Current Render Stats
The area of the Render Room displays statistical data concerning the rendering currently in progress.

MojoGraph

MojoGraph is an interface designed for digital effects professionals who want unrestricted access to MojoWorld's full power. It's the most advanced world and terrain creation software for 3D, print, and animation. The Pro User Interface, or Function Graph Editor, is a way to get "under the hood" of MojoWorld and create textures of practically unlimited complexity. The Function Graph Editor is a visual editor for mathematical functions. These mathematical functions are what drive the procedural elements of MojoWorld. By connecting together Function Nodes you build up a Function Graph to describe the mathematical functions that produce the information that the Real Time and Photorealistic Renderers use to generate images of MojoWorlds.

But be warned: even in the top Hollywood effects houses, there are very few people who know how to use a tool this advanced. So don't worry if you have trouble making sense of it. It's an advanced interface; something for you to grow into as you become a truly expert MojoWorld user.

This section will cover:
• Function Graphs — how to access and use them
• Creating Animated Content for MojoMove
• Creating Hyperspace Mixers
• A listing of nodes — both by category and alphabetically

Why Use MojoGraph?

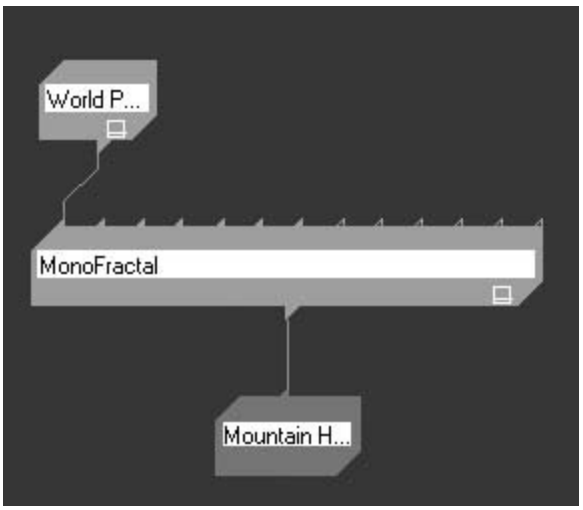
Given that the Generator Editors will build these Graphs for you, you may wonder why you would want to go to the trouble of creating your own Graphs. The main reason is that MojoGraph lets you do things that the Generator Editors can't do. The Editors use a fixed structure and only a small subset of the available Function Nodes. At the time of writing, there are close to 100 different Nodes available in MojoGraph, and the Generator Editors use about 30 of them. Some of these other Nodes are simple variations on the ones available in the Editors while others are highly specialized Nodes to achieve very specific effects. All the Nodes are documented in the following Node Reference section. Keep visiting mojoworld.org, as we'll be posting tutorials there for creating complex effects using MojoGraph.

Two significant features are unique to MojoGraph. The first is the ability to create new animated content. The MojoMove add-in allows MojoWorld Standard users to use existing animated content, however, new animated content can only be created in MojoGraph. The second is the ability to create Hyperspace Mixer sliders. If a planet has Hyperspace Mixers defined, they will be available when the planet file is opened by any version of MojoWorld, however new Hyperspace Mixers can only be created in MojoGraph.

Tutorials for each of these features can be found in the help files, and in the printed manual's MojoGraph chapter, immediately before the Node Reference section, at the end of the section on Creating Graphs.

What Is a Function Graph?

A Function Graph consists of a number of Nodes, hooked together in a tree structure rooted at a Parameter. Information starts at the topmost Nodes of the tree (the Leaf Nodes), flows down through the entire tree, and ends up setting the value of the Parameter at the bottom.



Let's look at an example of a very simple tree driving the terrain height of a MojoWorld. The Mountain Height Parameter is at the bottom of the tree. Above that, we have a Monofractal, the output of which is hooked into the Mountain Height Parameter. Above the Monofractal, a World Position Node's output is hooked into the Monofractal's Position Parameter. The World Position Node has no Parameters, and is therefore a Leaf of the tree. MojoWorld creates the world position information as needed and passes it to the Node. The World Position Node then passes that information down to the Monofractal, as the position in space at which to evaluate the fractal. The Monofractal calculates its result and passes that value down to the Mountain Height Parameter, which uses it to define the height of the mountains

on the MojoWorld. This height information is calculated point-by-point at the request of the MojoWorld renderers.

Another equally valid way to look at the processing is to go from the bottom to the top of the tree. The height Parameter asks the Monofractal for a height value, and the Monofractal asks the world position for the point at which it should calculate this height.

Textures Are Function Graphs

When you open the Generator Texture Editor and start creating Texture Leaf Nodes and Blend Nodes, beneath that interface MojoWorld is building a Function Graph. Everything that you create in the Generator Texture Editor corresponds to one or more Function Graph Nodes, all connected up into a single larger function. If you create very complex textures in the Generator, the underlying Graphs can have more than 50 Nodes, all coming together to create one color or height value. Materials in and of themselves are not function graphs, but parameters of materials and blends between material leaves can be function graphs. For instance, a single ‘material’ can be a blend of up to four different material ‘leaves’ and each of those leaves may be of differing types. Because those different material types may not share the same parameters, a material cannot be a single function graph.

Caution!

A Word of Caution

The Function Graph Editor is actually a visual programming interface. It lets you create completely arbitrary Function Graphs from any of the available Nodes. While this gives you an enormous amount of control, it also opens the door for strange and unpredictable results. While the Generator Editors restrict you to creating functions that are, for the most part, sensible and “safe,” Function Graphs have no such safeguards. There is nothing to stop you from specifying illegal mathematical operations like dividing by zero or taking the square root of a negative number.

While we’ve done our best to make things as robust as possible, there’s always the possibility of creating Graphs that will seriously confuse MojoWorld. Not that this should dissuade you from experimenting, but as with any programming language it is just as easy to create a bug as it is to create something correctly. Probably easier!

Getting to the Function Graphs

You can get to the Function Graph Editor from a number of places in the Generator Interface. Any material parameter that can be driven with a texture can also be driven by a Function Graph by choosing “Function” instead of “Texture” when clicking on the semi-circle widget attached to that material parameter. For graphs started in this way, the Function Graph Editor will open and will contain only the single root parameter node. In the Texture Editor any of the Leaf Nodes can be converted to a Function Graph by selecting that from the drop down list of available texture Leaves. In both the Texture Editor and the Material Editor, a blend node of type ‘blend’ is itself a Texture Leaf Node which has the option to be converted to a Function Graph. To view Function Graphs created by converting a texture leaf, click on the Circle-F to open the Function Graph Editor.

IMPORTANT NOTE: Once you convert a texture to a Function Graph there’s no going back. It will show up as a Circle-F in the Texture Editor from then on. This is because the Texture Editor trees can always be (and in fact always are) mapped into Function Graphs, but Function Graphics are more flexible, and therefore cannot be mapped into Texture trees.

Tip

Well, there’s almost no going back. If you’ve converted a single texture leaf to a function, you can still open the texture leaf DDLB and pick the original texture leaf — the ‘Convert Texture Leaf to Function’ act actually converts a clone of the texture leaf. If you’ve converted a texture-driven parameter to a function, going back is a two-step process. First, use the semi-circle to change the parameter back to a texture. This will result in a texture with a single leaf that is still a function graph. Next, look in the DDLB in the upper left corner of the texture editor to find the original texture that was driving the parameter

before its conversion to a function. It will still be there because MojoWorld will have cloned the entire texture before converting it to a Function Graph, though if it didn’t have a good, descriptive name, it may be hard to find!

Function Graph Editor Overview

The Function Graph Editor has the same basic layout as all the other Editors. The left hand side shows the current Graph, and the right hand side shows the Control Stack for the currently selected Function Node. This Control Stack is identical to the Control Stacks of other Editors, but with one slight difference. Some of the Nodes that are used in the Generator Texture Editor have “hidden” Parameters. These are values that the Generator sets, that are important to the correct behavior of the Texture and Material Editors. In the Function Graph Editor you can control these values.

When you open the Graph Editor for an existing Function Graph its layout is displayed. When you’re creating a new Graph from scratch, you’ll see one brown Node at the bottom indicating representing the Parameter that the Graph drives.

The Graph Nodes

A beveled box containing the name of the Node identifies each Node in the Function Graph Editor. The currently selected Node is red; unselected Nodes are gray. The output Parameter Node is brown so you know where to hook the final result. Click on a Node to select it, and drag to move Nodes around the window.

Tip

A newly created node is red, too, so it's possible to have two red nodes in a graph at once.

Across the top of each Node are a number of small triangles. Each triangle represents a Parameter of the Node, and corresponds to Parameter appearing in the Control Stack. If a Parameter can have a Node connected to it, the triangle is solid; otherwise it is just an outline. In the same way that some things can't have textures on them, some Parameters can't have other Nodes connected to them (as those other Nodes are in effect textures themselves). At the bottom of each Node is a single output triangle. In the bottom right corner is a collapse box that collapses this Node and all the Nodes above it down to the Node to which its output is connected.

Some nodes have "auto-configured" parameters. This means there will be no triangles corresponding to those inputs until the output of the node is hooked to the input of another, thus telling the parameters what data type they should be. Once the output of a node with auto-configured parameters is connected, all the parameters become available.

Tip

If you use an auto-configured node for one data type, you cannot re-use that node for a different data type. For example, if you connect an Add node and it auto-configures to be a 2D vector, you cannot re-use this Add node to add a 3D vector, because it has already auto-configured to use the 2D vector data type. You must instead create a new node and connect it to the new data type input in order for the auto-configured parameters to pick up the new data type.

Creating Graphs

You create Graphs by dragging the output triangle of one Node onto the input of another. You will see the connection line following as you drag. When the line gets near a Parameter that it can connect to it snaps to that Parameter and the line turns yellow to indicate a connection. Releasing the mouse button completes the connection. You can drive many Parameters from a single Node, so you can drag the output of a Node to the inputs of many other Nodes. This is useful for Nodes like World Position, which tend to be used in lots of different places in a Graph. To change or delete a connection select the Parameter input on the top of a Node. You can drag this connection to any other input, or drop it on the background to break the connection. You can add Nodes to the Graph from the menu at the top of the window. The “New Node...” option brings up a dialog box and allows you to select a new Node to create from a list of all available Nodes. You can drag it anywhere in the Graph Window.

The “Import from other graph...” option displays a list of the currently available Graph Nodes and lets you select one to import into the Graph. That Node and the tree of other Nodes that are connected to its input appear in your current Graph. You can use this if you want to share a chunk of a Graph across multiple things, for example creating a mountain height graph and a surface color graph that both use the same fractal function. Note that this is not a copy but the original Node itself, so any changes made to an imported Node also affects any other places where that Node is used.

Tip

It’s helpful to give unique names to the more significant nodes in your graphs, particularly when you want to use the same node in several graphs via this “Import from other graph” dialog.

The “Delete Node” option will delete the currently selected node, and remove all the connections into and out of it. If this node is shared across multiple graphs, it is deleted from all of the graphs in which it appears. The “Remove Node” option will only remove the currently selected node from the graph being edited. If this node is shared across multiple graphs, it remains unchanged in those other graphs. The “Auto Layout” option will organize the graph on screen in an orderly manner.

Tip

When your Graph becomes large and complex you can use the ‘,’ and ‘.’ keys to zoom in and out of the Graph. By holding down the space bar, you can drag the entire Graph around the window. The easiest way to understand the Function Graph Editor is to see it in action, so check the MojoWorld CDs and mojoworld.org for more examples.

Creating Animated Content for MojoMove

There are three mini-tutorials which show the basics of creating animated content for MojoMove.

The first creates a simple animated four-dimensional texture.

The second creates a moon that moves along its orbit over time.

The third creates a repeating animation.

While all of these animations can also be created using the older Time and Spacetime nodes, creating them with the MojoMove nodes will also set up shortcut access to many of the parameters via the

MojoMove Editor.

Creating MojoMove Content

A Simple Four-Dimensional Texture

Mini-Tutorial

This animated texture may be applied any texture-able element in MojoWorld. We'll start by assuming that the parameter to be animated does not yet have any texture driving it. A good parameter to use when playing through this tutorial is the density of a cloud layer. Instead of changing the density parameter from 'widget' to 'function' right away, set it first to 'texture' so we can get some default nodes into the graph. In the texture editor, choose 'New Texture,' then click the circle-T to enable the default texture leaf. Convert the default Texture Leaf to a function then click the circle-F to open the Graph Editor. This builds a graph with a World Position leaf node, a Monofractal node, and a Texture Color Control node.

Select the Monofractal node and change its 'Input domain' parameter to 4. Select the World Position node and delete it. Create a new MM World Position node from the MojoMove category. Connect the MM World Position's output to the Position parameter of the Monofractal node. (Using a MM World Position node allows users who do not have the MojoMove package to open this file and still have a sensible texture, as the nodes above the MM World Position will be pruned off and the MM World Position node will simply output the same value as a plain World Position node.) Create a new MM Spacetime node from the MojoMove category and connect its output to the MM World Position's 'Override' parameter. The MM Spacetime node has in it the hooks which will show up in the MojoMove editor.

The relative sizes of the Time Scale parameter in the MM Spacetime node and the fourth field of the Largest Feature Size parameter on most of the four-dimensional fractals will control the speed of the four-

dimensional motion. In the Monofractal node in our Cloud Density function, the Largest Feature Size defaults to 1000 in all four of the vector element fields. This will create rather small clouds, and with the Time Scale of 1 in the MM Spacetime node, the clouds will not seem to move at all. You may change the Time Scale to be close in value to the Largest Feature Size, or you may change the fourth field of the Largest Feature Size to a number closer to the default Time Scale value of 1.0. The important thing here is that when the sizes of these two parameters are similar, there will be apparent motion of the texture over time. If the Time Scale is much smaller than the fourth field of the Largest Feature Size, motion will be extremely slow or appear not to move at all. If the Time Scale is much larger than the fourth field of the Largest Feature Size, the motion will appear as visual noise.

Tip

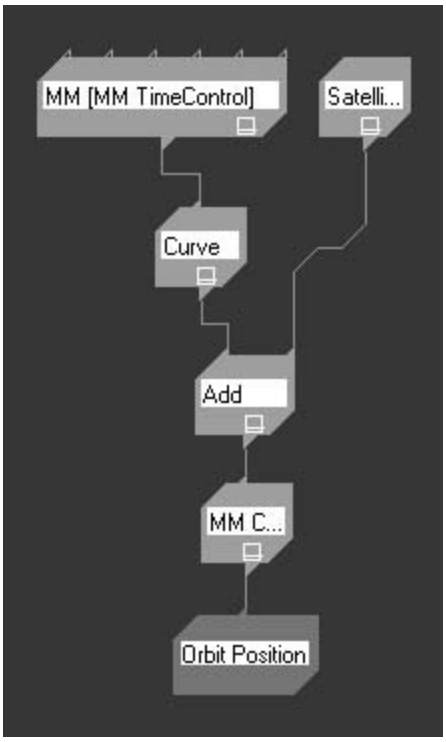
Use the preview renderer in the MojoMove editor to test the various Time Scales.

Creating MojoMove Content

Driving a Moon on its Orbit

Mini-Tutorial

The Moon Orbit Position parameter in the Moon Editor and the Sun Orbit Position parameter in the Sun Editor both have a semi-circle widget, but the choices on it are different from all other semi-circle widgets. The choices are ‘Widget’ and ‘Time Graph.’ Because there really only is one function graph for these parameters which makes any kind of sense, selecting Time Graph will automatically build a MojoMove graph for the Sun or Moon that will include an Orbital Speed parameter configured in Degrees Per Second.



Once an orbiting body is configured with the standard orbit-driving time graph, it can be moved in a couple of different ways. Changing the Time of Day in the Time Editor will move all orbiting bodies at the same time. The dial found on the Satellite Dial 1 node is the same as the Time of Day dial in the Time Editor, so moving one will move the other (as well as moving all of the orbiting bodies). Changing just the Time Offset for the Sun or an individual Moon will move only the Sun or that Moon. Recording time will also move an object with such a time graph. To keep an object with this type of time graph from moving during an animation, set the Orbital Speed to 0.

The use of any other graph besides the Time Graph on the Orbit Position is not recommended!

Creating MojoMove Content

An Animation Instance

Mini-Tutorial

Animation Instances are good on many different parameters. This tutorial will modify the sunlight to change from red to blue. Because the Mode, Start Time, and Duration parameters of the MM Instance node are duplicated in the MojoMove Editor, the end user can decide if they want the sun to be red for the first five seconds of their movie and then fade to blue over a duration of 10 seconds and remain blue for the rest of the clip (one-shot mode with a start time of 5 and a duration of 10), or if they want their sun to fade from red to blue and pop back to red every 10 seconds (repeat mode with a duration of 10 seconds), or if they want their sunlight to shift from red to blue back to red over and over again throughout the movie's duration (pendulum mode).

Access the Sunlight Editor. The fastest way to this editor is by opening the Object List and double-clicking on the Sunlight object line. In the Sunlight editor, if the Sunlight Color parameter is anything other than a widget, first change it to a widget to clear any texture or graph that may be attached to it. Once the Sunlight Color is a color dot, change it to a function. Create a MM Cap node and connect its output to the Sunlight Color parameter. This allows users without the MojoMove package to load this file and have a Sun Color color dot widget, as the graph will be pruned off at the MM Cap node. Create a Texture Color Control node and connect its output to the MM Cap Override parameter. Edit the Gradient in the Texture Color Control node so that the left end of the gradient is red and the right end of the gradient is blue. Create an MM Instance node and set the Control Name to 'Red Light, Blue Light.' Set the Tool Tip parameter to 'Changes sunlight from red to blue.'

The default values for the Mode, Start Time, and Duration parameters will have red sunlight at the first frame of a movie, fade the sunlight to blue over the first second and have it remain blue for the remainder of the movie.

Creating Hyperspace Mixers

In earlier versions of MojoWorld, creating Hyperspace Mixers was a cryptic process after which there was no way to tell, just by looking at the UI, whether any given parameter was under the control of a Hyperspace Mixer or not. The only way to change one of these mixers was to delete it and re-create it. And it was impossible to edit how the mixer affected the parameters under its control. The method for creating Hyperspace Mixers in version 3.0 makes it very clear what parameters are controlled by mixers and allows those mixers to be edited at any time after their creation.

IMPORTANT NOTE: The methods of mixer creation between versions 2 and 3 are incompatible, so when version 3.0 opens older planets, none of the Hyperspace Mixers will be present.

Another exciting benefit of the new method for Hyperspace Mixer creation is that the mixers are now associated with the elements of the world to which they are attached. For example, if you create a Land Texture and then create a Hyperspace Mixer named ‘Mountain Height’ that modifies the Result Scale parameter of a fractal node in your Land Texture, and finally export that Land Texture to a library item, that ‘Mountain Height’ mixer will be a part of that library and will load in to any new world when the Land Texture library item is loaded.

The first mini-tutorial on creating Hyperspace Mixers will do just that.

The second mixer mini-tutorial will attach a mixer to a parameter

which normally cannot be changed from 'widget.'

Creating Hyperspace Mixers

A Land Texture with a Mountain Height Hyperspace Mixer

Mini-Tutorial

Start with File>New. Click the circle-T for the Land Texture, create a new texture, and name it ‘Simple Tiny Mountains.’

Enable the first texture leaf and also name it ‘Simple Tiny Mountains.’

Select the Monofractal node and set the Result Scale parameter to 500. This will create some very small and simple default mountains.

Now change the Result Scale parameter to a function. Create a Curve node and set the Min Output and Max Output parameters in the Curve to -500 and 500, respectively.

Create a Hyperspace Mixer node and connect its output to the Curve Point parameter of the Curve node.

Set the Hyperspace Mixer’s Control Name to ‘Mountain Height’ and set the Tool Tip to ‘Varies mountain height between -500 and 500 meters.’ Set the initial mixer value to 1.0 to make the terrain look the same as when the Result Scale was directly set to 500. When the mixer is set to 0.5, the terrain will be flat. With the mixer set to 0.0, the terrain will be inverted, for example where there was a mountain peak will now be a valley and where there was a valley will now be a mountain peak. Once created, the mixer can be accessed in the Graph Editor, or in the Hyperspace Mixer available on the Generator’s Editors menu, or in the Hyperspace Mixer panel in the Viewer UI.

Back in the Land Texture editor, choose ‘Save to Library’ and save

‘Simple Tiny Mountains’ as a .mjl file. This file may be loaded into new worlds or shared with other MojoWorld users. When this Land Texture library item is loaded into a world, the Mountain Height Hyperspace Mixer will be available.

Creating Hyperspace Mixers

Creating a Sea Level Hyperspace Mixer

Mini-Tutorial

A common mixer to make would be to control the Sea Level. Looking in the Ocean Editor, however, the Sea Level parameter cannot be changed to a function! So, how can we attach a Hyperspace Mixer function graph to this parameter?

There is a preference in the Preferences Editor called ‘Force Functionable’. When this preference is enabled, many parameters throughout the Generator interface that normally would not have the semi-circle widget, allowing that parameter to be connected to a texture or a function, will get a semi-square widget. The semi-square widget only allows a parameter to be set to widget or function — it does not include texture as an option. When working in a Function Graph attached to a parameter which has a semi-square widget, the Graph Editor will have a red border. This is to remind you that this is a parameter that will not be happy with just any old graph.

With semi-squares enabled, open or create a world with an ocean. Note that in the Ocean Editor, the Sea Level parameter now has a semi-square widget. Use this widget to change the Sea Level parameter to a function. Create a Curve node and hook its output to the Sea Level parameter. Edit the curve so that its Min Output corresponds to the lowest desired Sea Level value and its Max Output corresponds to the highest desired Sea Level value. Create a Hyperspace Mixer node. Connect its output to the Curve Point parameter.

Set the Control Name to ‘Sea Level.’ Set the Tool Tip and initial Mixer position as desired.

If this ocean is saved to a library preset, the Sea Level Hyperspace Mixer will be saved with it.

Node Reference

The list of Nodes available in MojoGraph is already large. As new MojoWorld Function Node plugins are very easy to write, we are adding to the list on an ongoing basis. We'll be releasing new Function Node plug-ins on mojoworld.org as they are completed.

There is a complete reference for all the Nodes that are shipped on the MojoWorld CDs in these help files and in the printed manual. Each of the Nodes is of a specific type. When you work in the Generator Interface, these types are all hidden and you don't have to think about them. In MojoGraph, however, you need to know what type of information a Node generates as output and expects as input to its Parameters. The type of each input to a Node is noted in the description of the Nodes below.

For some Nodes the type is flexible. These Nodes create their output type when they are hooked up to the input of another Node, and become whatever type that Node requires. An example is the Add Node, which can add two things of any type. If you hook this up to a Node expecting colors, it configures itself to add three values corresponding to the three components specifying a color. Similarly, if you hook this up to the Position input of a fractal, it configures itself to add vectors of the size the fractal expects. These flexible Nodes can't know what type of input they'll need before they know what type of output they'll be asked to provide. Until you hook up such Nodes their Parameters will appear blank. (This means that there will be no spikes on top of their box in the Graph Window until their output is hooked up.) Nodes of this flexible type are labeled "Autoconfigured."

The available Parameter types are:
Integer - any whole number (e. g. 0, 1, 2) Integers may be represented by a slider widget or by a checkbox widget.

Real - any real or floating point number (e. g. 1.23, 476.45, 3.14159). Reals are normally represented by the thumbwheel widget.

2D Vector, 3D Vector 4D Vector - an array of real numbers of the size given.

Color - an RGB or HSL color value. MojoWorld always treats colors as RGB, but you can convert them inside a function to HSL if desired.

Alpha Color - An RGB color with an alpha channel. The alpha channel is a value between 0.0 and 1.0 specifying a transparency. This is rarely used.

Click here to see a listing of Nodes by Category.

See the table of contents for an alphabetical listing of Nodes.

Nodes by Category

Math Function Nodes

Leaf Nodes

Fractal Texture Nodes

Utility Nodes

PBombs

River Nodes

MojoMove Nodes

Math Function Nodes

These Nodes apply common mathematical operations to their input values.

- Absolute Value
- Add
- Angle
- Average
- Cosine
- Distance
- Divide
- Dot Product
- Max
- Min
- Modulo
- Multiply
- Power
- Rotate
- Sine
- Square
- Square Root
- Subtract
- Tangent

Leaf Nodes

Leaf Nodes supply information about the world to Parameters lower down in a Function Graph. Leaf Nodes generally have no inputs (although there are a couple of exceptions, see each Node for details).

- Altitude
- Altitude and Slope
- BoundingBox Pos
- Constant
- Fractal Position
- Latitude
- Marker Location
- Object Center Point
- Object Position
- Object Size
- Ray Direction
- Satellite Dial 1
- Satellite Dial 2
- Slope
- Spacetime
- Sun Direction
- Surface Normal
- Surface Position
- Time
- Undisplaced Slope
- Undisplaced Surface Pos
- Undisplaced World Pos
- UV Position
- World Position

Fractal Texture Nodes

Fractal Texture Nodes are more complex than the basic math operators, but they work the same way — data goes in, and it comes out changed. This is a very dynamic set of Nodes! Some of these will be familiar as the fractals available in the Generator Texture Leaf kickstands.

There are a number of variants on the Multifractal, all of which have similar but different behavior. This is because designing a good fractal function is as much art as science, and during the development of MojoWorld, we have found occasions where all the functions have proved useful. Some experimentation is always a good thing when looking for a fractal to perform a certain task.

Distorted Heterofractal 1D, 2D, 3D, 4D
- Distorted Monofractal 1D, 2D, 3D, 4D
- Distorted Multifractal 1D, 2D, 3D, 4D
- Function Heterofractal
- Function Monofractal
- Function Multifractal
- Heterofractal
- Monofractal
- Mountain Fractal
- Multifractal
- New Multifractal
- Noise
- Ridged MultiFractal
- Vector Noise

Many Fractal Texture Nodes have similar Parameters that serve the same function in each. These common Parameters are:

Position: The set of points at which the fractal is evaluated. The position Parameter should be connected to a Leaf Node depending on

the space in which you want to evaluate the fractal. To get domain distortion effects the Leaf Node may be combined with another function before being passed to the position Parameter of another Function Node. In some fractal texture Nodes this Parameter is named “Evaluation Point.” This parameter is only visible in MojoGraph for the fractal nodes that are available in Generator Texture Leaves.

Largest Feature: The distance between the high points of the largest feature of the fractal, roughly speaking. For height textures, think of this as the distance between mountaintops.

Smallest Feature: Fractals keep adding detail down to a certain size, usually about one pixel. Use this control to increase that size to remove the fine detail from a fractal and smooth it out at smaller scales. For height textures, think of this as the distance between the smallest hilltops. If this is set to 0.0, the detail is always as fine as possible. This parameter is hidden in ‘Simple’ mode for fractals that are available in Generator Texture Leaves.

Position Scale: The Position scale is similar to the Largest Feature Size in the Generator fractals, but works inversely. A largest feature of 1000.0 would be expressed as a position scale of 0.001 (or 1.0/1000.0). While the newer fractal Nodes all use Largest Feature, some of the “historical” fractals still use this Parameter.

Position Offset: Using an analogy of a fractal as a bitmap image, the offset would correspond to where that image is positioned. It has the effect of sliding the fractal around. Another type of domain distortion can be introduced by driving the Position Offset with a function. For some Fractal Texture Nodes, this parameter is simply called ‘Offset.’ This parameter is hidden in ‘Simple’ mode for the fractal nodes which are available in Generator Texture Leaves.

Result Scale: A multiplier for the final result of the fractal. Most fractals range in value from approximately -1.0 to 1.0. The result scale multiplies this before it is returned, making that range larger or smaller.

Basis Function: Most of the fractal Nodes have this Parameter. When first created, a texture Node with a Basis Function Parameter shows it defaulting to “None.” Clicking the button brings up a DDLB listing the available basis functions.

Utility Nodes

This is a collection of Nodes that perform various useful functions, or perform with a single Node some operation that might take a larger Function Graph.

- Bitmap
- Bitmap Heightfield
- Blend
- Crater
- Curve
- Difference Blend
- Hsl to Rgb
- Hyperspace Mixer
- Object Distance
- Ocean Depth
- Rgb to Hsl
- Set Vector Length
- Texture Color Control
- Vector Combine
- Vector Element

PBombs

This family of nodes are used with Parameter Bombs.
- PBomb Axis
- PBomb Position
- PBomb Value
- PBomb World Position

Each of these Nodes has a Parameter Bomb Object DDLB. This DDLB lists Parameter Bombs that have been defined in the current world file. PBomb Nodes do not function until associated with a Parameter Bomb. Prior to Version 3, these nodes were called ‘Helper Nodes.’

River Nodes

The River Nodes are used in conjunction with the River Terrain Parameter Bomb to create realistic flows of rivers across terrain. See the Rivers tutorial in the Generator chapter's section on Parameter Bombs.

A separate appendix includes additional information about the River Terrain Parameter Bomb.

- TZ Beach Blend
- TZ River Depth
- TZ River Slope
- TZ Rivers
- TZ Terrain
- TZ Texture

MojoMove Nodes

These nodes allow for shortcut access between the Pro UI function graphs and the MojoMove Editor. They also allow MojoWorld Standard users with the MojoMove add-in to use animated presets without access to MojoGraph.

- MM Instance
- MM SpaceTime
- MM Time
- MM WorldPos Rotate
- MM Cap
- MM World Pos

Alphabetical Node List - A

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Absolute Value – Math Nodes
Outputs the absolute value of the single input.

Abs Point (Autoconfigured)
If the input at Abs Point is negative, its value is changed to positive. If the input is positive, it is unchanged.

Add – Math Nodes
Outputs the sum of the two input values.

Add 1 (Autoconfigured)
Input to be added to Add 2.

Add 2 (Autoconfigured)
Input to be added to Add 1.

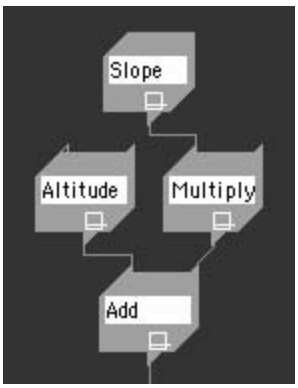
Altitude – Leaf Nodes
Outputs the local terrain height of the MojoWorld or terrain patch. The Altitude node only has meaning when used in textures or functions driving parameters of materials applied to the planet. Certain primitives may respond differently with an Altitude based texture. For example, the terrain patch primitive derives its altitude from its Height Texture parameter rather than its position in World Space.

Use Sea Level (Integer)
When checked, the altitude values will be relative to the sea level of the Ocean object. When there is no Ocean or when this parameter is
unchecked, the altitude values are the raw Mountain Height output.

Offset (Real)
A value added to the raw altitude values.

Altitude and Slope – Leaf Nodes
Outputs a value representing both the altitude and slope of the current terrain. The slope is 1.0 where the terrain is locally horizontal and 0.0 where terrain is a vertical cliff. Certain primitives may respond differently to an Altitude and Slope based texture. For example, the terrain patch primitive derives its Altitude and Slope values from its Height Texture parameter rather than its position in World Space.

The Altitude and Slope node is a short-cut for a more complex graph of four nodes. At the base is an Add node. The Add 1 parameter takes its data from an Altitude node. The Add 2 parameter takes its data from a Multiply node. The Multiply 1 parameter takes its data from a Slope node and the Multiply 2 parameter corresponds to the Slope Weight parameter of the Altitude and Slope node.



This node is most commonly used in Land Material blends. It has the effect of blending by altitude, but in the transition zone, also blending by slope. In that transition zone, the part of the blend corresponding to low altitudes is also put onto the flat slopes. The part of the blend corresponding to high altitudes is also applied to the steep slopes. To put the low altitude output onto the steep slopes and the high altitude output onto the flat slopes, one must build the more complex graph shown above, insert a Curve node in between the Slope and Multiply nodes, and then invert that Curve.

Slope Weight (Real)
The slope is multiplied by this value before being added to the altitude.

Use Sea Level (Integer)
When checked, the altitude values will be relative to the sea level of the Ocean object. When there is no Ocean or when this parameter is un-checked, the altitude values are the raw Mountain Height output.

Alt Offset (Real)
A value added to the raw altitude values.

Angle - Math Nodes
Outputs the angle, in degrees, between two vectors.

Vector 1 (3D vector)
Any vector.

Vector 2 (3D vector)
Any other vector.

Average – Math Nodes
Outputs a 50/50 blend of the two values. For vector values, each component is averaged.

Average 1 (Autoconfigured)
The value to be averaged with Average 2.

Average 2 (Autoconfigured)
The value to be averaged with Average 1.

Alphabetical Node List - B

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Bitmap – Utilities
A Bitmap Node contains a bitmap for use as a model's texture, or for data to drive a Parameter Bomb.

Bitmap Point (2D vector)
Usually connected to a UV Position Node when used to apply bitmaps to imported models; may be a PBomb Position. In Generator Texture Leaves, this parameter is hidden and takes its value from the Input Coordinate portion of the texture leaf kickstand.

File Name (String)
The name of a bitmap file. A new file may be loaded using the 'Load from Disk' icon at the end of the field.

Bitmap Size (2D vector)
This allows the bitmap to be scaled on the X and Y axes independently. Values for the Bitmap Size will depend upon the context in which the Bitmap Node is being used.

Bitmap Offset (2D vector)
This allows the bitmap to be moved along the X and Y axes independently. Values for the Bitmap Offset will depend upon the context in which the Bitmap Node is being used.

Tile (Integer)
If this is "on" the bitmap is repeated when the input coordinates go outside the range set by the scale Parameters. If this is "off" it returns the minimum value outside that range.

Loaded (Integer)
This parameter is only visible in MojoGraph. It is a read-only indicator of whether MojoWorld has found the bitmap file. For example, when a world file is opened, MojoWorld will prompt for any bitmap files it cannot find. If that prompt is cancelled, the Loaded parameter will not be checked, but the filename field will retain the original bitmap filename information.

Flip Horizontal (Integer)

Flips the bitmap left to right.

Flip Vertical (Integer)

Flips the bitmap top to bottom.

Rotate Bitmap

This DDLB lists options for rotating the bitmap. The default is “No Rotation.” The other three options specify an angle to rotate by in a clockwise direction.

Bitmap Heightfield – Utilities
This Node is similar to the Bitmap Node, but uses grayscale bitmaps instead of color bitmaps. It is generally used to create terrain, interpreting the grayscale values as height of points on a Terrain Patch or inside of a Parameter Bomb.

Bitmap Point (2D vector)
Height is evaluated at the Bitmap Point. This will commonly be a PBomb Position when used as terrain inside of a Parameter Bomb, or it may be a UV Position if used on a Terrain Patch primitive. In Generator Texture Leaves, this parameter is hidden and takes its value from the Input Coordinate portion of the texture leaf kickstand.

File Name (String)
The Bitmap Height Node can use either standard image files or Digital Elevation Model (DEM) files. DEM's generally produce significantly better terrains because they feature much greater accuracy in their height values. For exchanging terrains with Bryce, the PGM format is highly recommended, as Bryce will read in a PGM as a native Bryce terrain object.

Height Scale (Real)
A value by which the output is multiplied. Some Bitmap Heightfield formats (DEM, in particular) have Height Scale information included in the data and so this field takes its information from that source.

Height Offset (Real)
The altitude to which the lowest value in the bitmap maps. Use this and the Height Scale values to rescale and translate the terrain vertically.

Bitmap Size (2D vector)
This allows the bitmap to be scaled on the X and Y axes independently. Values for the Bitmap Size will depend upon the context in which the Bitmap Heightfield is being used.

Bitmap Offset (2D vector)
This allows the bitmap to be moved along the X and Y axes independently. Values for the Bitmap Offset will depend upon the context in which the Bitmap Heightfield is being used.

Tile (Integer)
If this is "on" the bitmap is repeated when the input coordinates go outside the range set by the scale Parameters. If this is "off" it returns the minimum value outside that range.

Bicubic (Integer)
When this is checked, a bicubic interpolation will be used for resizing the bitmap information. When this is un-checked, a linear

interpolation will be used. Generally, bicubic interpolation will produce smoother results.

Blend – Utilities
Used to mix together the effects of two functions. The mixing proportion can be driven by a third function. The Blend Node is very commonly used, and is the heart of the Generator Texture Blends. The Blend Node can combine two functions continuously to provide smooth transitions between two arbitrary inputs, usually Textures or Materials. Such transitions are useful in countless ways in the construction of MojoWorlds.

The two inputs to be blended are called the Blend Low and High Values. You may want the blend to occur between some arbitrary boundaries, such as between the altitudes of 10,000 and 12,000m as for modulating a snow line. These bounds are controlled with the Blend Range Low and High Values. Finally, something must specify how much of each of the blended inputs appears in the output. That proportion can range from all of one and none of the other, to the exact opposite. The Blend Value Parameter controls this proportion.

Blend Low Value (Autoconfigured)
The input value going into the low end of the blend. Also the output value of the Blend Node when the Blend Value input falls below the Blend Range Low value. The data type of this Parameter remains undefined until the Node is connected into a Function Graph.

Blend High Value (Autoconfigured)
The input value going into the high end of the blend. Also the output value of the Blend Node when the Blend Value input exceeds the Blend Range High value. The data type of this Parameter remains undefined until the Node is connected into a Function Graph.

BoundingBox Pos – Leaf Nodes
A coordinate space which ranges from 0 to 1 across the bounding box

of a primitive or imported object.

De-stretch Mode
This DDLB lists the possible modes for how the space should scale when the object is scaled. The default is ‘None’, which means that the space stretches and scales with the bounding box. The other choices are: Longest Side, Shortest Side, Average Side, X, Y, and Z. When a single side is selected, the texture is “de-stretched” and is uniformly scaled proportionally to the side chosen.

Blend Range Low (Real)
The lower boundary of the Blend range. Defaults to 0.0. The blend occurs on input values that fall between the Blend Range Low and Blend Range High Values. Input values outside this range are not blended, but are 100% one of the two inputs.

Blend Range High (Real)
The upper boundary of the Blend range. Defaults to 1.0. The blend occurs on input values that fall between the Blend Range Low and Blend Range High Values. Input values outside this range are not blended, but are 100% one of the two inputs.

Blend Value (Real)
The Blend Value is most interesting when driven by a function. If this value is a constant (such as the default of 0.5) the result is a constant ratio of the Blend Low and High Values.

Alphabetical Node List - C

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Camera Location – Leaf Nodes
This node outputs the location of the current camera. It is similar to the Marker Location node, but always assumes that it is the position of the active camera as opposed to a specific camera or location of a specific object.

Constant – Leaf Nodes
Outputs a constant value. The data type is specified by the user, it is not autoconfigured. It can appear as a coordinate input in Generator Texture Leaves.

Type
The default data type is Real. Other data types which can be selected include: Integer, Vector 2D, Vector 3D, Vector 4D, and Color.

Value
The widget shown for the value depends on the data type. Once the data type has been specified, the value can be set to the desired constant value to be output by the node.

Cosine – Math Nodes
Cosine is a math function that calculates the cosine of an angle given in radians.

Cosine Point (Autoconfigured)
The input on which to evaluate the cosine. For vectors, the cosine is calculated for each element of the vector.

Crater – Utilities
The Crater Node simulates the falloff of a crater shape. It is generally

used inside a Parameter Bomb. This Node has been superseded by the Parameter Bomb Falloff Curve, but it can still be useful.

Crater Position (2D vector)
The evaluation point for the Crater. Craters live inside a square that has a size that is dependent on the

Crater Radius (see below).

Crater Radius (Real)
The radius of the outermost influence of the Crater profile.

Crater Depth (Real)
The altitude at the bottom of the Crater.

Crater Rim Height (Real)
The height of the circular rim that surrounds the Crater.

Crater Center Height (Real)
The Crater Center Height is the height of the central peak in the crater.

Curve – Utilities
Provides access to the Curve Editor.

Curve Position (Real)
The data passed to the curve. This parameter is only visible in MojoGraph.

Edit Curve Button
Opens the Generator Interface Curve Editor.

Alphabetical Node List - D

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Difference Blend – Utilities
Returns the difference between two colors.

Color 1 (Color)
The first color for evaluation.
Color 2 (Color)
The second color for evaluation.

Distance – Math Nodes
Calculates the distance between two points. You can use it to make functions whose effects vary with the distance from objects (e.g. Marker Flags).

Distance Position 1 (3D vector)
An arbitrary 3D point or vector.
Distance Position 2 (3D vector)
An arbitrary 3D point or vector.

Distorted Heterofractal 1D, 2D, 3D, 4D - Distorted Fractals
Distorted Monofractal 1D, 2D, 3D, 4D - Distorted Fractals
Distorted Multifractal 1D, 2D, 3D, 4D - Distorted Fractals
The distorted fractals are in the category of “use at your own risk.” These are powerful but slow fractals whose time has not yet come — our computers simply aren’t fast enough to deal with them yet. They can employ up to three different basis functions at different scales, with smooth transitions between them. They also feature domain distortion that can be tailed off at small scales, the so-called “Viscous Damping.” For the 1D versions, the point and scale are real numbers, while the higher dimensional versions take vectors of the appropriate size.

The Heterofractal family is very smooth at its sea level, and gets rougher as it goes above and below that altitude. The Monofractal family is the simplest fractal, and is equally rough everywhere. The Multifractals are complex fractals that are rougher in some places and smoother in others.

The following parameters are the same in all three types of Distorted Fractal Node:

Evaluation Point (Vector or Real, depending on dimension)
The Evaluation Point is the sample point where the fractal is calculated.
Generally takes a World Position Node as its input.

Scale (Real or Vector)
Scale is the inverse of, or 1.0 over, the Largest Feature. See the Fractal
Texture Nodes introduction before the Node Reference for more information.

Translation (Real or Vector)
Translation or “offset” is the distance to move along the various position axes before evaluating the fractal. This has the effect of moving the fractal around.

Amplitude (Real)
Amplitude is the amount by which the result is scaled before output.

Roughness (Real)
Modulates the fractal dimension. Smaller values yield a smoother fractal; larger ones make the fractal spiky. The useful range is roughly –0.5 to 0.7.

Detail (Real)
When this value is 0.0, pixel-sized detail is computed. Larger values add detail; negative values subtract detail. Use Detail to modulate the “busyness” of your fractals. Sometimes you don’t

want pixel-sized detail everywhere, all
the time.

Frequency Change Per Octave (Real)
The difference in size between successive copies of the basis function used in the construction of the fractal. Usually left at a value around 2.0. Larger values can speed up evaluation, at the cost of introducing visual artifacts.

Domain Distortion (3D vector)
A vector added to the Evaluation Point before computing the fractal.
A Noise or Fractal function generally drives the Domain Distortion.

Viscous Damping Begin/End (2D vector)
The two components of this vector determine the scales where the Domain Distortion starts to fade out, and where it goes to zero. Use this to get domain distortion on large features, that disappears for small features.

First Crossover Begin/End (2D vector)
The two components of this vector determine the scales where the first Basis Function starts to fade out and the second to fade in, and where the fade is complete. Use this to build fractals that have one character at large scales, that given by the first Basis Function, fading to another at smaller scales, that given by the second basis function. Crossovers are optional.

Second Crossover Begin/End (2D vector)
As above, fading between the second and third Basis Functions, if any.

Large Scale Basis
Specifies the Basis Function to be used for large features of the fractal. This is the only Basis Function that must be specified.

Mid Scale Basis
Specifies the optional second Basis Function to be used for medium sized features of the fractal, if a Crossover is desired.

Small Scale Basis
Specifies the optional third Basis Function to be used for small features of the fractal, if a second Crossover is desired.

The Distorted Heterofractals and Distorted Multifractals also have the 'Sea Level' parameter:

Sea Level (Real)
The level at which the fractal is smoothest. As the fractal gets above or below this, it will get progressively rougher. This is specified before Amplitude is applied, so it will generally range from -1.0 to 1.0.

The Distorted Multifractals have two additional parameters

Gain (Real)
A scale factor applied to the basis function during fractal construction. Larger values will increase the roughness of rough areas.

Leakage (Real)
Allows higher frequencies to leak through where the normal Multifractal would be very smooth. This introduces small-scale roughness into smooth areas.

Divide - Math Nodes

A math function that outputs the result of the first input divided by the second. Note that dividing by very small numbers can produce very large results, so some care is needed when creating textures with this, particularly with the height textures. You should avoid dividing by zero.

Divide 1 (Autoconfigured)
The numerator. The data type remains undefined until the output of the Node is connected to another Node.

Divide 2 (Autoconfigured)

The denominator. The data type remains undefined until the output of the Node is connected to another Node.

Dot Product – Math Nodes

Returns the dot product between two 3D vectors. If the vectors are of unit length, the dot product is the cosine of the angle between them.

Vector 1 (3D Vector)
A vector.

Vector 2 (3D Vector)
Any other vector.

Alphabetical Node List - F

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Fractal Position – Leaf Nodes
An input coordinate that varies per octave for the Function Fractals. This Node is only useful when used in a section of a Function Graph that is hooked up to the Basis Function Parameter of a Function Fractal. See the Function Fractal Nodes for more information on using this Node.

Function Heterofractal – Fractals

Function Monofractal – Fractals

Function Heterofractal – Fractals
The Function Fractal family of Nodes uses an arbitrary function as the Basis Function rather than a simple noise value. This can create some strange and unusual effects. All of the three standard fractal functions are available as Function Fractals, and share most of the same Parameters.

Position (3D vector)
This is the point at which the fractal is to be evaluated. Normally this uses a World Position node as its input, possibly modified by some domain distortion function.

Pos Scale (3D vector)
Pos Scale multiplies the Position to scale the size of the fractal. It is the inverse of the Largest Feature parameter on the standard fractal Nodes. See the notes in the Fractal Texture Nodes introduction.

Pos Offset (3D vector)

Moves the fractal around.

Result Scale (Real)
Result Scale is the amount by which the calculated fractal value is multiplied before output.

Roughness (Real)
Modulates the fractal dimension. Smaller values yield a smoother fractal; larger ones make the fractal spiky. The useful range is roughly –0.5 to 0.7.

Lacunarity (Real)
The difference in size between successive copies of the basis function used in the construction of the fractal. Usually left at a value around 2.0. Larger values can speed up evaluation, at the cost of introducing visual artifacts.

Basis (Real)
The arbitrary basis function from which the Function Fractal is built.

IMPORTANT NOTE: The Function Graph hooked up to the Basis input must be driven by the Fractal Position Node, rather than the usual World Position Node. The Fractal Position Node is automatically updated by the Function Fractal in the way that's necessary to ensure proper construction of the Function Fractal.

The Multifractal and Heterofractal Function Fractal nodes also have additional Parameters.

Heterofractal Sea Level (Real)
The level at which the fractal is smoothest. As the fractal gets above or below this, it will get progressively rougher. This is specified before Amplitude is applied, so it will generally range from -1.0 to 1.0.

Multifractal Offset (Real)
Closely related to Heterofractal Sea Level, but affects the overall

variable roughness character of the Multifractal.

Multifractal Gain (Real)
Similar to Roughness, but affects the local areas of roughness.

Alphabetical Node List - H

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Heterofractal – Fractals
The general Heterofractal Node used by Texture Leaf Nodes in the Generator. This fractal can vary its input dimension based on an input Parameter, so some of the other Parameters will change their type depending on that setting. The Heterofractal has a parameter called ‘Zero Offset.’ When the ‘Zero Offset is set to 0.0, the fractal is smooth (identical to a noise) and has no fractal detail. As it gets above or below that level, it will become progressively rougher.

Position (Real or Vector)
Position is the point at which the fractal is to be evaluated. Note that this Parameter is only visible in MojoGraph.

Largest Feature (Real or Vector)
The size, in meters, of the largest features.

Smallest Feature (Real or Vector)
The size, in meters, of the smallest features. This parameter is hidden in ‘Simple’ mode.

Offset (Real or Vector)
Moves the fractal around. This parameter is hidden in ‘Simple’ mode.

Result Scale (Real)
Result Scale is the amount by which the calculated fractal value is multiplied before output.

Roughness (Real)

Modulates the fractal dimension. Smaller values yield a smoother fractal; larger ones make the fractal spiky. The useful range is roughly –0.5 to 0.7.

Detail (Real)
When this value is 0.0, pixel-sized detail is computed. Larger values add detail; negative values subtract detail. Use Detail to modulate the “busyness” of your fractals. Sometimes you don’t want pixel-sized detail everywhere, all the time. This parameter is hidden in ‘Simple’ mode.

Zero Offset (Real)
The level at which the fractal is smoothest. As the fractal gets above or below this, it will get progressively rougher. This is specified before the Result Scale is applied, so it will generally range from -1.0 to 1.0. This parameter is hidden in ‘Simple’ mode.

Lacunarity (Real)
The difference in size between successive copies of the basis function used in the construction of the fractal. Usually left at a value around 2.0. Larger values can speed up evaluation, at the cost of introducing visual artifacts. This parameter is only visible in MojoGraph.

Fixed Octave Count (Integer)
Generally, MojoWorld automatically adjusts the Octave Count to get the appropriate level of detail in your images. When a fractal is used for domain distortion, however, this can cause errors in rendering, so sometimes we want to use a fixed number of octaves. The Generator Texture leaves use this option by default in fractals invoked for domain distortion. This parameter is only visible in MojoGraph.

Rotate per Octave (Integer)
When unchecked, the copies of the noise which make up the fractal are always in the same orientation. The lack of rotations is particularly evident with basis functions that are strongly

directional, such as the checkerboard, linear, steps and steep steps basis functions. This parameter is hidden in ‘Simple’ mode.

Fractal Calming
Checked by default and only applies to fractals with an Input Domain of 4. This parameter is only visible in MojoGraph.

Calming Value
A damping value applied to the W component of the dimensional vector. This keeps the high time frequencies from becoming too noisy. The range is 0 to 1, where 0 produces the same result as leaving the Fractal Calming parameter unchecked. This parameter is only visible in MojoGraph.

Input Domain (Integer)
Defines the number of input dimensions. The Input Domain can be set to 1, 2, 3 or 4. Use 1D fractals for things based on altitude or slope. 2D fractals can be used inside Parameter bombs or in UV texture space and 3D fractals are generally used for everything else. The 4D versions of the fractals are generally used only in conjunction with the Time Node for special animation effects. This parameter is only visible in MojoGraph. It will automatically adjust itself according to the input coordinates used in the Generator Texture Leaf kickstand.

Basis Function
Opens a DDLB that lists all available Basis Functions.

HSL to RGB – Utilities
Interprets the input value as a color in the hue, saturation and lightness (HSL) color space and converts it into the corresponding color in the red, green, and blue (RGB) color space. Values generally lie in the range 0.0 to 1.0 regardless of the color space.

HSL (color)
The HSL color to convert.

Hyperspace Mixer – Utilities

This node is used to create Hyperspace Mixers in Viewer Mode and in the Generator's Hyperspace Mixer Editor. The output of a Hyperspace Mixer node will always be 0.0 to 1.0. Most commonly, the output of a Hyperspace Mixer will go through a Curve node before any parameter it is to drive. See the mini-tutorials on creating Hyperspace Mixers for more information.

Control Name (String)
The name of the Hyperspace Mixer.

Tool Tip (String)
Text to display as a tool tip when the user hovers the mouse pointer over the Hyperspace Mixer.

Mixer (Real)
This slider ranges from 0.0 to 1.0 and specifies the initial start point for the Hyperspace Mixer in the Viewer and Generator Modes. Changes to this slider in MojoGraph will be reflected in the other interfaces and vice versa.

Live (Integer)
When a Hyperspace Mixer is live, the planet will update in the RTR as the slider is moved by the user. If the Live checkbox is not checked, then the changes to the planet will appear in the RTR only after the user releases the slider. Some changes will never show in the RTR, such as changes to atmospheric density or to the star backdrop, as those elements of the planet are not displayed in the RTR.

Alphabetical Node List - L

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Latitude – Leaf Nodes
This Node returns the current evaluation point as a value between -90 and 90, where negative values are in the Southern hemisphere.

Alphabetical node List - M

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Marker Location – Leaf Nodes
This Node returns the location of the origin of an object. Although designed to work with Marker Flags, any object in the scene can be used as the marker object for this Node. It returns the point in World Space of the center of the transform handles for the selected object. Cameras are listed in the Marker Object list, however you may want to use the Camera Location node instead if you wish the effect to be relative to the currently active camera rather than a specific camera.

Marker Object
Opens a DDLB which lists all of the current scene objects and lets you select the object to which the Marker Location Node applies.

Max – Math Nodes
A math function that outputs the larger of its two inputs. For vectors, this is done on a per-component basis.

Max Value 1 (Autoconfigured)
Max Value 2 (Autoconfigured)

Min – Math Nodes
A math function that outputs the smaller of its two inputs. For vectors, this is done on a per-component basis.

Min Value 1 (Autoconfigured)
Min Value 2 (Autoconfigured)

MM Cap – MojoMove
Provides a ‘clean break’ between a single animated parameter and an arbitrarily complex graph. This allows world files containing animated content to be opened by users without the MojoMove add-in and still get sensible results.

Override (Autoconfigured)
An arbitrarily complex graph which must contain at least one of the following nodes: MM Instance, MM SpaceTime and/or MM Time.

MM Instance – MojoMove
The output of an MM Instance node will always be a value between 0.0 and 1.0. Some parameters of an MM Instance node will also be available in the MojoMove Editor.

Control Name (String)
The name of the control stack branch which is created in the MojoMove Editor.

Tool Tip (String)
A text string which will appear as a tool tip when the mouse hovers over the corresponding control stack branch in the MojoMove Editor.

Mode (DDLB)
This drop-down list box contains the options: One Shot, Pendulum, and Repeat. This DDLB will also show in the MojoMove Editor. ‘One Shot’ means that the specified action happens only one time. ‘Pendulum’ means that the specified action will go forward and then ‘rewind’ in a cycle over the course of recorded time. ‘Repeat’ means that the specified action will start over from the beginning continuously throughout recorded time.

Start Time (Real)
For a ‘One Shot’ action, this will be the time (in seconds) at which the action is to start. For ‘Pendulum’ or ‘Repeat’ actions, this will be an offset. The place at which the pendulum or repeat cycles start is interpolated along the cycle backwards to time 0. This control will also show in the MojoMove Editor.

Duration (Real)

The time (in seconds) that the action is to last. This control will also show in the MojoMove Editor.

Live
Whether or not the RTR should be updated ‘in real time’ when the Global Time dial is moved. Checking this can significantly slow the response of the whole MojoWorld UI, so it is not recommended for anything other than driving orbits and moving clouds.

Output Style
This DDLB provides two choices. The default is ‘Constant [0.0->1.0]’ where the values being output will range from 0.0 to 1.0 including values in between 0.0 and 1.0. The other choice is ‘Fixed [0 or 1]’ where the values being output will be either 0 or 1.

MM SpaceTime – MojoMove
Much like the existing Spacetime node, but allows controls to also be available in the MojoMove Editor dialog. A MM SpaceTime node must be connected to the MM World Position node.

WorldPos Override (3D Vector)
This allows the MM SpaceTime to act on an alternate coordinate space, such as Object Position.

Control Name (String)
The name of the control which will show up in the MojoMove Editor.

Tool Tip (String)
A text string which will appear as a tool tip when the mouse hovers over the corresponding MojoMove control in the MojoMove Editor.

Time Scale (Real)
The time scale usually is on the same order of magnitude as the Largest Feature Size of the fractal to which this node is used as the input position. See the ‘Creating Animated Content’ mini-

tutorials for more information. Used as the initial value for the control in the MojoMove Editor.

Live
Whether or not the RTR should be updated ‘in real time’ when the Global Time dial is moved. Checking this can significantly slow the response of the whole MojoWorld UI, so it is not recommended for anything other than driving moving clouds.

MM Time – MojoMove
The output of this node is the Time in seconds multiplied by the Scale parameter plus the Time Offset: newtime = (time * scale) + offset

Control Name (String)
The name of the control stack branch which will show up in the MojoMove Editor.

Tool Tip (String)
A text string which will appear as a tool tip when the mouse hovers over the corresponding control stack branch in the MojoMove Editor.

Time Offset (Real)
The number of seconds by which time is offset.

Scale (Real)
A factor by which the raw time is multiplied.

Live
Whether or not the RTR should be updated ‘in real time’ when the Global Time dial is moved. Checking this can significantly slow the response of the whole MojoWorld UI, so it is not recommended for anything other than driving orbits and moving clouds.

MM World Position – MojoMove
This allows world files containing animated content to be opened by users without the MojoMove add-in and still get sensible results. When

there is no override parameter, this node returns the same result as a standard World Position node. The most common node to attach to the Override parameter is a MM SpaceTime node

Override (4D vector)
An MM SpaceTime node must be present in the graph above this parameter, though the output of the MM SpaceTime may be modified by an arbitrarily complex graph before connecting to this Override parameter. Caution must be used to ensure that the data remains a 4D vector.

MM WorldPos Rotate – MojoMove
This node rotates the entire World Position coordinate system relative to either the planet's North/South axis or relative to fixed user-defined point. Rotating the World Position coordinates over time gives a very directional motion and is used most often for drifting clouds.

Control Name (String)
The name of the control which will show up in the MojoMove Editor. The default value is, "Move Direction."

Tool Tip (String)
Text which will be used as a tool tip for the control in the MojoMove Editor. The default value is, "The 'Compass Direction' the movement is going
to follow."

Direction (Real)
This dial widget gets duplicated in the MojoMove Editor. Changes to the dial in MojoGraph are reflected in the MojoMove Editor and vice-versa.

Amount (Real)
Generally this value needs to change over time in order for movement to progress. Depending on the motion desired, either an MM Time node or an MM Instance node may be appropriate.

Modulo – Math Nodes

A math function that outputs the remainder of the division of the first value by the second. As with Divide, avoid division by zero. That condition is handled internally by MojoWorld, but the results may not be what you expect. For vectors and colors, this Node operates on a per-component basis.

Modulo Value (Autoconfigured)
The numerator, or the number being divided.

Modulo Base (Autoconfigured)
The denominator, or the number being divided by.

Monofractal – Fractals
The general Monofractal Node used by Texture Leaf Nodes in the Generator. This fractal can vary its input dimension based on an input Parameter, so some of the other Parameters will change their type depending on that setting. The Monofractal is the simplest fractal. It is equally rough everywhere.

Position (Real or Vector)
Position is the point at which the fractal is to be evaluated. Note that this Parameter is only visible in MojoGraph.

Largest Feature (Real or Vector)
The size, in meters, of the largest features.

Smallest Feature (Real or Vector)
The size, in meters, of the smallest features. This parameter is hidden in ‘Simple’ mode.

Offset (Real or Vector)
Moves the fractal around. This parameter is hidden in ‘Simple’ mode.

Result Scale (Real)
Result Scale is the amount by which the calculated fractal value is multiplied before output.

Roughness (Real)
Modulates the fractal dimension. Smaller values yield a smoother fractal; larger ones make the fractal spiky. The useful range is roughly –0.5 to 0.7.

Detail (Real)
When this value is 0.0, pixel-sized detail is computed. Larger values add detail; negative values subtract detail. Use Detail to modulate the “busyness” of your fractals. Sometimes you don’t want pixel-sized detail everywhere, all the time. This parameter is only visible in MojoGraph.

Lacunarity (Real)
The difference in size between successive copies of the basis function used in the construction of the fractal. Usually left at a value around 2.0. Larger values can speed up evaluation, at the cost of introducing visual artifacts. This parameter is only visible in MojoGraph.

Fixed Octave Count (Integer)
Generally, MojoWorld automatically adjusts the Octave Count to get the appropriate level of detail in your images. When a fractal is used for domain distortion, however, this can cause errors in rendering, so sometimes we want to use a fixed number of octaves. The Generator Texture and Material Editors use this option by default in fractals invoked for domain distortion. This parameter is only visible in MojoGraph.

Rotate per Octave (Integer)
When unchecked, the copies of the noise which make up the fractal are always in the same orientation. The lack of rotations is particularly evident with basis functions that are strongly directional, such as the checkerboard, linear, steps and steep steps basis functions. This parameter is hidden in ‘Simple’ mode.

Fractal Calming
Checked by default and only applies to fractals with an Input

Domain of 4. This parameter is only visible in MojoGraph.

Calming Value
A damping value applied to the W component of the dimensional vector. This keeps the high time frequencies from becoming too noisy. The range is 0 to 1, where 0 produces the same result as leaving the Fractal Calming parameter unchecked. This parameter is only visible in MojoGraph.

Input Domain (Integer)
Defines the number of input dimensions. The Input Domain can be set to 1, 2, 3 or 4. Use 1D fractals for things based on altitude or slope. 2D fractals can be used inside Parameter bombs or in UV texture space and 3D fractals are generally used for everything else. The 4D versions of the fractals are generally used only in conjunction with the Time Node for special animation effects. This parameter is only visible in MojoGraph. It will automatically adjust itself according to the input coordinates used in the Generator Texture Leaf kickstand.

Basis Function
Opens a DDLB that lists all available Basis Functions.

Local Point
This DDLB allows the axis of rotation to pass through either the current camera (the default), or through a fixed latitude/longitude point.

Latitude Point (String)
The data entry for this field is handled the same way as in the Navigation Panel. This parameter is only used if the Local Point DDLB has ‘Fixed lat/long point’ selected.

Longitude Point (String)
The data entry for this field is handled in the same way as in the Navigation Panel. This parameter is only used if the Local Point DDLB has ‘Fixed lat/long point’ selected.

Live (Integer)
Whether or not the RTR should be updated ‘in real time’ when the Global Time dial is moved. Checking this can significantly slow the response of the whole MojoWorld UI, so it is not recommended for anything other than moving clouds.

Mountain Fractal – Fractals
This is another variation on the Multifractal Node that lies somewhere between the original Ridged Multifractal and the Simpler Multifractal. This fractal can vary its input dimension based on an input Parameter, so some of the other Parameters will change their type depending on that setting. The Mountain Fractal features complex variation of roughness over space and altitude. Mountain Fractal is a type of multifractal, a complex fractal that is rougher in some places and smoother in others.

Position (Real or Vector)
Position is the point at which the fractal is to be evaluated. Note that this Parameter is only visible in MojoGraph.

Largest Feature (Real or Vector)
The size, in meters, of the largest features.

Smallest Feature (Real or Vector)
The size, in meters, of the smallest features. This parameter is hidden in ‘Simple’ mode.

Offset (Real or Vector)
Moves the fractal around. This parameter is hidden in ‘Simple’ mode.

Result Scale (Real)
Result Scale is the amount by which the calculated fractal value is multiplied before output.

Roughness (Real)

Modulates the fractal dimension. Smaller values yield a smoother fractal; larger ones make the fractal spiky. The useful range is roughly –0.5 to 0.7.

Detail (Real)
When this value is 0.0, pixel-sized detail is computed. Larger values add detail; negative values subtract detail. Use Detail to modulate the “busyness” of your fractals. Sometimes you don’t want pixel-sized detail everywhere, all the time. This parameter is only visible in MojoGraph.

Zero Offset (Real)
Changes the height on the Basis Function around which roughness changes are based, somewhat like Sea Level in a Heterofractal. It applies at each octave in the fractal, so smooth and rough areas may appear at any height. Generally, a value of 0.0 produces a very smooth terrain; larger values produce higher and rougher terrain. This parameter is hidden in ‘Simple’ mode.

Gain (Real)
A scale factor applied to the basis function during fractal construction. Larger values will increase the roughness of already rough areas. Negative values will make smooth areas rough, and produce some very strange and interesting landscapes. This parameter is hidden in ‘Simple’ mode.

Lacunarity (Real)
The difference in size between successive copies of the basis function used in the construction of the fractal. Usually left at a value around 2.0. Larger values can speed up evaluation, at the cost of introducing visual artifacts. This parameter is only visible in MojoGraph.

Fixed Octave Count (Integer)
Generally, MojoWorld automatically adjusts the Octave Count to get the appropriate level of detail in your images. When a fractal is used for domain distortion, however, this can cause errors in

rendering, so sometimes we want to use a fixed number of octaves. The Generator Texture and Material Editors use this option by default in fractals invoked for domain distortion. This parameter is hidden in ‘Simple’ mode.

Rotate per Octave (Integer)
When unchecked, the copies of the noise which make up the fractal are always in the same orientation. The lack of rotations is particularly evident with basis functions that are strongly directional, such as the checkerboard, linear, steps and steep steps basis functions. This parameter is hidden in ‘Simple’ mode.

Fractal Calming
Checked by default and only applies to fractals with an Input Domain of 4. This parameter is only visible in MojoGraph.

Calming Value
A damping value applied to the W component of the dimensional vector. This keeps the high time frequencies from becoming too noisy. The range is 0 to 1, where 0 produces the same result as leaving the Fractal Calming parameter unchecked. This parameter is only visible in MojoGraph.

Input Domain (Integer)
Defines the number of input dimensions. The Input Domain can be set to 1, 2, 3 or 4. Use 1D fractals for things based on altitude or slope. 2D fractals can be used inside Parameter bombs or in UV texture space and 3D fractals are generally used for everything else. The 4D versions of the fractals are generally used only in conjunction with the Time Node for special animation effects. This parameter is only visible in MojoGraph. It will automatically adjust itself according to the input coordinates used in the Generator Texture Leaf kickstand.

Basis Function
Opens a DDLB that lists all available Basis Functions.

Multifractal – Fractals

The general Multifractal Node used by Texture Leaf Nodes in the Generator Interface. This fractal can vary its input dimension based on an input Parameter, so some of the other Parameters will change their type depending on that setting. Multifractals are complex fractals that are rougher in some places and smoother in others. The Multifractal Node produces some of the most realistic terrain.

Position (Real or Vector)
The Position is the point at which the fractal is to be evaluated. Note that this Parameter is only visible in MojoGraph.

Largest Feature (Real or Vector)
The size, in meters, of the largest features.

Smallest Feature (Real or Vector)
The size, in meters, of the smallest features. This parameter is hidden in ‘Simple’ mode.

Offset (Real or Vector)
Moves the fractal around. This parameter is hidden in ‘Simple’ mode.

Result Scale (Real)
Result Scale is the amount by which the calculated fractal value is multiplied before output.

Roughness (Real)
Modulates the fractal dimension. Smaller values yield a smoother fractal; larger ones make the fractal spiky. The useful range is roughly –0.5 to 0.7.

Detail (Real)
When this value is 0.0, pixel-sized detail is computed. Larger values add detail; negative values subtract detail. Use Detail to modulate the “busyness” of your fractals. Sometimes you don’t want pixel-sized detail everywhere, all the time. This parameter is

only visible in MojoGraph.

Zero Offset (Real)
Changes the height on the Basis Function around which roughness changes are based, somewhat like Sea Level in a Heterofractal. It applies at each octave in the fractal, so smooth and rough areas may appear at any height. Generally, a value of 0.0 produces a very smooth terrain; larger values produce higher and rougher terrain. This parameter is hidden in ‘Simple’ mode.

Gain (Real)
A scale factor applied to the basis function during fractal construction. Larger values will increase the roughness of already rough areas. Negative values will make smooth areas rough, and produce some very strange and interesting landscapes. This parameter is hidden in ‘Simple’ mode.

Fine Detail (Real)
Where a multifractal has become smooth at some scale, it will generally remain smooth there at all smaller scales. This would lead to MojoWorlds that would lose all detail if you zoomed in close enough. Fine Detail allows the specified proportion of higher frequencies to leak back in, on a per-octave basis. This allows smooth areas to become rough again at smaller scales. Its valid range is normally 0.0 to 1.0. Values outside this range may produce bizarre results. This parameter is only visible in MojoGraph.

Lacunarity (Real)
The difference in size between successive copies of the basis function used in the construction of the fractal. Usually left at a value around 2.0. Larger values can speed up evaluation, at the cost of introducing visual artifacts. This parameter is only visible in MojoGraph.

Fixed Octave Count (Integer)
Generally, MojoWorld automatically adjusts the Octave Count to

get the appropriate level of detail in your images. When a fractal is used for domain distortion, however, this can cause errors in rendering, so sometimes we want to use a fixed number of octaves. The Generator Texture and Material Editors use this option by default in fractals invoked for domain distortion.

Rotate per Octave (Integer)
When unchecked, the copies of the noise which make up the fractal are always in the same orientation. The lack of rotations is particularly evident with basis functions that are strongly directional, such as the checkerboard, linear, steps and steep steps basis functions. This parameter is hidden in ‘Simple’ mode.

Fractal Calming
Checked by default and only applies to fractals with an Input Domain of 4. This parameter is only visible in MojoGraph.

Calming Value
A damping value applied to the W component of the dimensional vector. This keeps the high time frequencies from becoming too noisy. The range is 0 to 1, where 0 produces the same result as leaving the Fractal Calming parameter unchecked. This parameter is only visible in MojoGraph.

Input Domain (Integer)
Defines the number of input dimensions. The Input Domain can be set to 1, 2, 3 or 4. Use 1D fractals for things based on altitude or slope. 2D fractals can be used inside Parameter bombs or in UV texture space and 3D fractals are generally used for everything else. The 4D versions of the fractals are generally used only in conjunction with the Time Node for special animation effects. This parameter is only visible in MojoGraph. It will automatically adjust itself according to the input coordinates used in the Generator Texture Leaf kickstand.

Basis Function
Opens a DDLB that lists all available Basis Functions.

Multiply – Math Nodes

A math function that outputs the result of the first input multiplied by the second input.

- Multiply value 1 (Autoconfigured)
- Multiply value 2 (Autoconfigured)

Alphabetical Node List - N

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Noise – Fractals
Evaluates a single call to a Basis Function, which in this context is referred to as a “Noise” function. This is like a fractal with all the detail removed. Like the fractals, the dimension of this noise can vary based on its dimension Parameter.

Position (Real or Vector)
The Position is the point at which the noise is to be evaluated.

Largest Feature (Real or Vector)
The size, in meters, of the largest features.

Position Offset (Real or Vector)
Moves the Noise around.

Result Scale (Real)
Result Scale is the amount by which the calculated Noise value is multiplied before output.

Input Domain (Integer)
Defines the number of input dimensions. The Input Domain can be set to 1, 2, 3 or 4. Use 1D Noises for things based on altitude or slope. 2D Noises can be used inside Parameter bombs or in UV texture space and 3D Noises are generally used for everything else. The 4D Noises are generally used only in conjunction with the Time Node for special animation effects.

Basis Function
Opens a DDLB that lists all available Noise Basis Functions.

Alphabetical Node List - O

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Object Center Point – Leaf Nodes
This node outputs the position of the center of the object's bounding box. For some primitives, the center of the bounding box already corresponds to the origin of the primitive. Examples of primitives whose origin points coincide with the center of the bounding box include the sphere and the torus. Other primitives have their origin point at a corner or an apex rather than at the center of the bounding box. Examples of the origin not at the center of the bounding box include the box and the cone.

Space
This DDLB chooses between World Space or Object Space.

Object Distance – Utilities
Outputs the distance between an object and a specified point.

Position (3D Vector)
The point from which the distance to the object is returned.

Object
A DDLB listing available objects in the scene.

Object Position – Leaf Nodes
Outputs the current Object Space position. Object Space is defined as the local space in which an object is built. For the MojoWorld this will be the same as world space, but for other primitives this will be a space centered on their local origin. Use this space to construct textures that stick to objects as you move them around. Textures in Object Position space will scale with the object to which they are applied.

Object Size – Leaf Nodes

This node outputs the size of the object in the selected space. It is very useful for creating displacements which scale with the object. See the Moon tutorial for an example.

Size Metric

This DDLB lists the choices for how the coordinate system is scaled. The choices are: Longest Edge, Shortest Edge, Average Edge, Longest Diagonal, Shortest Diagonal, Average Diagonal, X Edge, Y Edge, and Z Edge. The default choice is Shortest Edge.

Space

This DDLB chooses between World Space or Object Space. The default choice is World Space.

Ocean Depth – Utilities

Outputs the depth of the ocean at a given point on the world surface. If this is positive, the land is below the water. Negative values indicate the land is above the water. If the MojoWorld has no ocean, this will output zero at all points.

Position (3D vector)

The point at which to evaluate the distance between the surface of the land and the surface of the ocean. Should use a World Position Node as its input.

Alphabetical Node List - P

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

PBomb Axis – Parameter Bombs
The PBomb Axis creates a 3D Vector that points in the direction from the center of the planet through the center of the Parameter Bomb. This vector is in World Space. It is synonymous with the local up direction at the center of the helper.

Parameter Bomb
Opens a DDLB that lists all available Parameter Bombs.

PBomb Position – Parameter Bombs
Outputs the Parameter Bomb Space point corresponding to the same point in World Space. Parameter Bomb Space is a two-dimensional space ranging from –1.0 to 1.0 on the x and y-axes. For a Circle Marquee Parameter Bomb object, PBomb Space is the circle inscribed in the square defined by those coordinates. Use this Node to convert from a World Space point into a local two-dimensional space for the parameter bomb.

World Position (3D vector)
The point at which to calculate the PBomb Space. Generally this uses a World Position Node as its input.

Parameter Bomb
Opens a DDLB that lists all available Parameter Bombs.

PBomb Value – Parameter Bombs
Provides a fade from the center of a Parameter Bomb to its edge. The default response is 0.0 at the edge, with a linear increase to 1.0 in the middle. This can be edited using the Response Curve available in the Parameter Bomb itself. For circular Parameter Bombs this is a radial falloff, while for square Parameter Bombs it is pyramidal in shape.

World Position (3D vector)
The point at which to calculate the PBomb Space.
Parameter Bombs
Opens a DDLB that lists all available Parameter Bombs.

PBomb WorldPos – Parameter Bombs
This Node is the reverse of the PBomb Position node. It takes a 2D point in PBomb Space (-1.0 to 1.0 in x and y) and returns the corresponding point on the surface of the MojoWorld. This point is a “surface point” in that it lies on the base surface of the MojoWorld, not the actual landscape. That is, its altitude will be zero; it will lie on the sphere at the Planet Radius.

Local Position (2D vector)
The point in PBomb Space to convert.
Parameter Bomb
Opens a DDLB that lists all available Parameter Bombs.

Power – Math Nodes
A math function that raises a number to a given power. Where the base is a vector, the exponent is applied to each component. Note that calling Power with certain input values is mathematically undefined, so this Node should be used with care. Unpredictable results can occur, particularly with negative bases and fractional exponents. In these cases, the view shown in the RTR window may be very different from what is produced in a final render.

Base (Autoconfigured)
The value to be exponentiated.
Exponent (Real)
A decimal number which defaults to 2.0 (which is the same as using a Square Node).

Alphabetical Node List - R

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Random Node – Utilities
The random node outputs a random value within a range based on the Position and Variance parameters.

Randomize
A punch-button widget which causes the node to select a new random value. Some objects, such as Boulders, will automatically trigger any Randomize buttons in any graphs associated with it when specific actions occur, such as cloning the Boulder.

Position
The value of the Position parameter represents an average or base value for the randomizations.

Variance
The Variance represents how much the Position value should be randomly varied. For example, if the Position parameter is 100 and the variance is 20, the random values will range approximately between 80 and 120.

Sigma
The model of randomization to use. Choices are Uniform, Linear, Quadratic, Cubic, and Quartic. The choices are in an increasing order. The higher the Sigma, the closer the random values will cluster around the original Position value, and the influence of the Variance parameter is lessened.

Ray Direction – Leaf Nodes
Gives the 3D vector direction for which the eye-point is pointing. You can use this information with an object material to change how the object can look from different viewing angles.

RGB to HSL – Utilities
Interprets the input value as a color in the red, green, and blue (RGB) color space and converts it into the corresponding color in the hue, saturation and lightness (HSL) color space. Values generally lie in the range 0.0 to 1.0 regardless of the color space.

RGB (color)
The color to convert.

Ridged Multifractal - Fractals
This is the earliest Node from which MojoWorld terrains were created. Although superceded by the current Multifractal, Mountain Fractal, and Simpler Multifractal Nodes, its behavior is subtly different, so it remains as an item of historical interest. This fractal type is only available in MojoGraph.

RMF Position (3D vector)
The point at which the fractal is evaluated. Normally this uses a World Position Node as its input.

RMF Pos Scale (3D vector)
Multiplier of the input Position point. This is the inverse of the Largest Feature on the new fractals.

RMF Pos Offset (3D vector)
Moves the fractal around.

RMF Result Scale (Real)
The amount by which the calculated fractal value is multiplied before output.

RMF Lambda (Real)
The difference in size between successive copies of the basis function used in the construction of the fractal. Usually left at a value around 2.0. Larger values can speed up evaluation, at the cost of introducing visual artifacts. Lambda the same as Lacunarity in the other fractal Nodes.

RMF Omega (Real)
Modulates the fractal dimension. Smaller values yield a smoother fractal; larger ones make the fractal spiky. The useful range is roughly –0.5 to 0.7. The same as Roughness in the other fractal Nodes.

RMF Offset (Real)
Changes the height on the Basis Function around which roughness changes are based, somewhat like Sea Level in a Heterofractal. It applies at each octave in the fractal, so smooth and rough areas may appear at any height. Generally, a value of 0.0 produces a very smooth terrain; larger values produce higher and rougher terrain. Positive values produce rougher, more mountainous terrain, while negative values will "invert" the terrain, producing wedge shaped valleys and smooth hilltops. RMF Offset is the same as Zero Offset in the Multifractal Node.

RMF Threshold (Real)
A scale factor applied to the basis function during fractal construction. Larger values will increase the roughness of rough areas. The same as Gain in the Multifractal Node.

Rotate – Math Nodes
Rotates a given point about a given axis by a given angle. This can be used with the Helper Axis and Helper Value Nodes to produce spiral tornado clouds.

Rotate Angle (Real)
The angle, in degrees, to rotate by.

Rotate Point (3D vector)
The point to rotate.

Rotate Axis (3D vector)
The axis to rotate about. This axis is set to unit length before rotation occurs.

Alphabetical Node List - S

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Satellite Dial 1 – Leaf Nodes
Outputs a value between 0 and 1 representing the position of the Time of Day dial in the Time Editor. See the MojoMove section relating to driving the sun and moon(s) along their orbits over time for more information on the usage of this node.

Satellite Dial 2 – Leaf Nodes
Outputs a value between 0 and 1 representing the position of the Time of Year dial in the Time Editor.

Set Vector Length – Utilities
Scales the input vector's length to the given value.

Length (Real)
The new value of the vector's length. Setting a vector's length to 1.0 is known as normalizing the vector.

Vector (Autoconfigured)
The vector to be modified.

Simpler Multifractal – Fractals
Another variation on the Multifractal Node that is closer to the original Ridged Multifractal that early MojoWorld users knew and loved. This fractal can vary its input dimension based on an input Parameter, so some of the other Parameters will change their type depending on that setting. Multifractals are complex fractals that are rougher in some places and smoother in others.

Position (Real or Vector)
The Position is the point at which the fractal is to be evaluated. Note that this Parameter is only visible in MojoGraph.

Largest Feature (Real or Vector)
The size, in meters, of the largest features.

Smallest Feature (Real or Vector)
The size, in meters, of the smallest features. This parameter is hidden in ‘Simple’ mode.

Offset (Real or Vector)
Moves the fractal around. This parameter is hidden in ‘Simple’ mode.

Result Scale (Real)
Result Scale is the amount by which the calculated fractal value is multiplied before output.

Roughness (Real)
Modulates the fractal dimension. Smaller values yield a smoother fractal; larger ones make the fractal spiky. The useful range is roughly –0.5 to 0.7.

Detail (Real)
When this value is 0.0, pixel-sized detail is computed. Larger values add detail; negative values subtract detail. Use Detail to modulate the “busyness” of your fractals. Sometimes you don’t want pixel-sized detail everywhere, all the time. This parameter is only visible in MojoGraph.

Zero Offset (Real)
Changes the height on the Basis Function around which roughness changes are based, somewhat like Sea Level in a Heterofractal. It applies at each octave in the fractal, so smooth and rough areas may appear at any height. Generally, a value of 0.0 produces a very smooth terrain; larger values produce higher and rougher terrain. This parameter is hidden in ‘Simple’ mode.

Gain (Real)

A scale factor applied to the basis function during fractal construction. Larger values will increase the roughness of already rough areas. Negative values will make smooth areas rough, and produce some very strange and interesting landscapes. This parameter is hidden in ‘Simple’ mode.

Lacunarity (Real)
The difference in size between successive copies of the basis function used in the construction of the fractal. Usually left at a value around 2.0. Larger values can speed up evaluation, at the cost of introducing visual artifacts. This parameter is only visible in MojoGraph.

Fixed Octave Count (Integer)
Generally, MojoWorld automatically adjusts the Octave Count to get the appropriate level of detail in your images. When a fractal is used for domain distortion, however, this can cause errors in rendering, so sometimes we want to use a fixed number of octaves. The Generator Texture and Material Editors use this option by default in fractals invoked for domain distortion. This parameter is hidden in ‘Simple’ mode.

Rotate per Octave (Integer)
When unchecked, the copies of the noise which make up the fractal are always in the same orientation. The lack of rotations is particularly evident with basis functions that are strongly directional, such as the checkerboard, linear, steps and steep steps basis functions. This parameter is hidden in ‘Simple’ mode.

Fractal Calming
Checked by default and only applies to fractals with an Input Domain of 4. This parameter is only visible in MojoGraph.

Calming Value
A damping value applied to the W component of the dimensional vector. This keeps the high time frequencies from becoming too noisy. The range is 0 to 1, where 0 produces the same result as

leaving the Fractal Calming parameter unchecked. This parameter is only visible in MojoGraph.

Input Domain (Integer)
Defines the number of input dimensions. The Input Domain can be set to 1, 2, 3 or 4. Use 1D fractals for things based on altitude or slope. 2D fractals can be used inside Parameter bombs or in UV texture space and 3D fractals are generally used for everything else. The 4D versions of the fractals are generally used only in conjunction with the Time Node for special animation effects. This parameter is only visible in MojoGraph. It will automatically adjust itself according to the input coordinates used in the Generator Texture Leaf kickstand.

Basis Function
Opens a DDLB that lists all available Basis Functions.

Sine – Math Nodes
A math function that calculates the sine of an angle given in radians.

Sine point
The data point of which to evaluate the sine. For vectors, the sine of each component is taken.

Slope – Leaf Nodes
Outputs the slope of the terrain at the given point. Slope is expressed as a value between 0.0 and 1.0. A slope of 1.0 is horizontal; a slope of 0.0 is vertical. This is a cosine function, so where the terrain is at 45 degrees, the value of the slope is 0.707. Certain primitives will respond differently to Slope driven textures. The Terrain Patch primitive gets its Slope from the Height Texture parameter. For Boulders and other primitives with undersides, the Slope may range from -1.0 to 1.0.

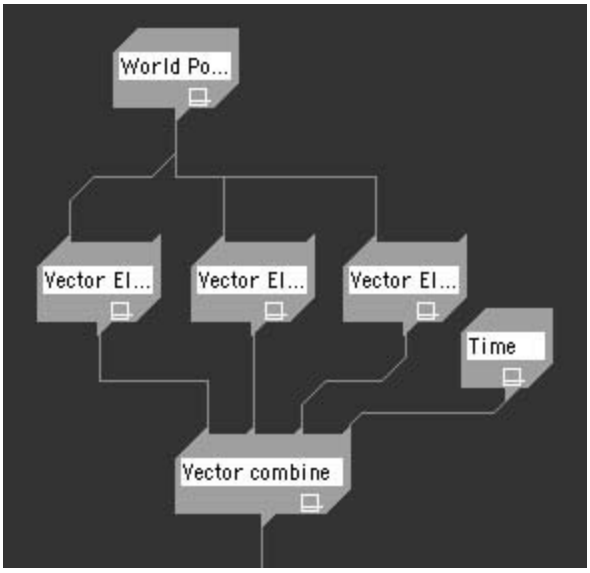
Spacetime – Leaf Nodes
Outputs a 4D vector where the first three components are the same as the World Position Node, and the fourth is the current animation time as defined by the Time Node. Use this Node as a shortcut to a

number of Vector Element Nodes and Vector Combine Node to get a 4D-spacetime vector.

Time scale

Scales the time component of the 4D vector, to control the speed of animations.

The following function graph is the graph for which the Spacetime node is a shortcut.



Square – Math Nodes

A math function that multiplies the input value by itself. For vectors, the individual components are squared.

Value (Autoconfigured)

The value to be squared.

Square Root – Math Nodes

A math function that takes the square root of the input value. This operation is undefined for negative numbers; 0.0 is returned in this case.

Value (Autoconfigured)

The value of which to take the square root.

Subtract – Math Nodes

A math function that outputs the difference of two inputs.

Subtract 1 (Autoconfigured)
The value from which the second input is subtracted.

Subtract 2 (Autoconfigured)
The value to subtract from the first input.

Sun Direction – Leaf Nodes
Gives the 3D vector direction that the sunlight is coming from with regard to the current evaluation point. You can use this information with a material to change how the material can look when the sunlight hits it at different angles.

Surface Normal – Leaf Nodes
Gives the 3D vector direction of the current surface normal. You can use this node in combination with the Ray Direction node to determine how a material will look at different viewing angles.

Surface Position – Leaf Nodes
Outputs the World Position projected onto the planet's base radius sphere. Planet Mountain Height functions always map this internally to a world space point, so in order to get a material texture to match a height texture on a planet, use Surface position rather than World position for the material texture. This node produces the same result as a World Position node run through a Set Vector Length node to set its length to 1.0.

Alphabetical Node List - T

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Tangent – Math Nodes
A math function that returns the tangent of an angle given in radians. Note that as the value approaches Pi/2, the tangent goes to infinity, which will cause grief to MojoWorld. Therefore, this Node should be used with caution.

Tangent point (Autoconfigured)
The value of which to take the tangent.

Texture Color Control – Utilities
Invokes the Output Control Node of the Generator Texture Editor. See the Generator Texture Editor section for more information on these controls.

> Input Value (Real)
> The value passed to the Color Controls. This parameter is only visible in MojoGraph.
>
> Input Curve
> A gray scale Curve used to modify the value before passing it to the Gradient.
>
> Gradient
> A Color Gradient driven by the Input Curve.
>
> Output Curve
> A color Curve used to modify the result of the Gradient.

Time – Leaf Nodes

Outputs the time, in seconds, of the current animation. This Node is “experimental,” in that it was very easy to add and should work in most circumstances, but has not been thoroughly tested and verified. You will probably never see the result of a Time Node in the RTR, because it changes every frame of an animation, and the RTR isn’t informed of these changes (as each potentially represents a Hyperspace Jump). The new MojoMove nodes are designed to work more closely with the RTR.

TZ Beach Blend – Rivers

The TZ Beach Blend node is used to blend between the Beach material and the Land material during rendering. It selects the Beach material under and immediately adjacent to river, lake, and ocean water in the Parameter Bomb, and the Land material elsewhere. A distinct material or materials (such as Sand and/or Rock) applied to beaches can make the terrain look much more realistic. The node returns a blending value between 0.0 and 1.0, with 0.0 pure land and 1.0 pure beach. The Beach Blend node is set up automatically when the Parameter Bomb is created, but is not activated until the beach material is connected to the Parameter Bomb material tree.

Blending Curve (curve)
The sharpness of the transition between the Land and Beach materials and the width of the beaches adjacent to the water can be adjusted by editing the blending curve. Beaches get wider as the step in the blending curve is moved to the left.

River/Terrain Generator (list)
Selects the River/Terrain Generator to which this node is coupled. This is set automatically when the Parameter Bomb is created, and should not be changed.

TZ River Depth – Rivers

The node outputs the total water depth, from the land height to the maximum of the river water height and the ocean water height, within the Parameter Bomb. A negative value is returned if the current location is not in a river and not below sea level. The value passes

smoothly through 0 at the land-water boundary, a typical positive value in a river is around 5-10, and negative values around -10 to -20 occur fairly close to rivers. One use for this node is reduce water and land material displacement amplitudes to zero at the edge of the water. The MojoWorld renderer often produces artifacts if there are displacements at the water-land boundary. The River Depth is calculated before any displacements in the water or land materials are applied. If the current location is outside the Parameter Bomb boundaries the value returned is 0.

River/Terrain Generator (list)
When you create a new TZ River Depth node in the Pro Interface, you must select the River/Terrain Generator Parameter Bomb to which it will be applied. Otherwise, the node will have no effect.

TZ River Slope – Rivers
This node outputs a measure of the slope of the water surface. The slope value is the tangent of the slope angle divided by one plus the tangent. The slope is based on smooth (bi-cubic) interpolation from the water heights on the Parameter Bomb grid, before any displacements are applied to the water material. The slope values range from 0.0 for a flat surface, to 0.5 for a 45 degree slope angle, to 1.0 for a vertical surface. (This is very different from the MojoWorld Slope Node, which outputs the cosine of the slope angle.) The River Slope node can be used in designing custom river water materials, to control wave displacements and the blend between normal water and white water, for instance. The River Slope value is set to 0.0 at all locations outside the boundaries of the Parameter Bomb, and at points where the river water surface is below sea level. The River Slope value at a point above sea level and not in a river or lake is not meaningful.

River/Terrain Generator (list)
When you create a new TZ River Slope node in the Pro Interface, you must select the River/Terrain Generator Parameter Bomb to which it will be applied. Otherwise, the node will have no effect.

TZ Rivers – Rivers
This node is used by the height function graph inside a River/Terrain

parameter bomb to generate, from the bitmap of height values for the River Terrain plus any procedural extra detail, the land and water height values used by the MojoWorld renderer.

River/Terrain Generator (list)
Selects the River/Terrain Generator to which this node is coupled. This is set automatically when the Parameter Bomb is created, and should not be changed.

TZ Terrain – Rivers
This node can be substituted for the TZ Rivers node. It generates land heights in the same way as TZ Rivers, but without any river water. You see the river terrain as if all the rivers had dried up in a drought.

River/Terrain Generator (list)
Selects the River/Terrain Generator to which this node is coupled. This is set automatically when the Parameter Bomb is created, and should not
be changed.

TZ Texture - Rivers
This node is used by the water-land material blend inside a River Terrain parameter bomb. It returns 1.0 wherever the water height is greater than the land height, and 0.0 everywhere else.

River/Terrain Generator (list)
Selects the River/Terrain Generator to which this node is coupled. This is set automatically when the Parameter Bomb is created, and should not
be changed.

Alphabetical Node List - U

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Undisplaced Slope – Leaf Nodes
Outputs the slope of the terrain at a given point prior to displacement.

Undisplaced Surface Pos – Leaf Nodes
Outputs the Surface Position prior to displacement.

Undisplaced World Pos – Leaf Nodes
Outputs the World Position prior to displacement.

UV Position – Leaf Nodes
Outputs the two-dimensional UV Space coordinates of points on the surface of primitives. UV Space coordinates are generally used for mapping bitmap textures onto primitives. Each MojoWorld primitive has a UV Space defined for it. For example, the cylinder varies U from 0.0 to 1.0 around the circumference, and V from 0.0 to 1.0 along the length. For imported meshes, the UV Space will be that supplied by the mesh. If the imported mesh has no UV coordinates, UV Position will output (0.0, 0.0).

Alphabetical Node List - V

Since this list is alphabetical and not sorted by category, it may not be immediately obvious which category to look in, so each node listed is followed by the category in which it can be found.

Vector Combine – Utilities
Outputs a 4D vector constructed from the specified inputs. If you are using this to drive another Node that takes a vector smaller than 4D, then there is no need to hook anything up to extra dimensions. Just leave them at their default value and MojoWorld will construct a vector of a smaller dimension for you.

X (Real)
Value of the x coordinate of the new vector.

Y (Real)
Value of the y coordinate of the new vector.

Z (Real)
Value of the z coordinate of the new vector.

W (Real)
Value of the w coordinate of the new vector.

Vector Element - Utilities
Extracts a single component from a vector.

Vector (4D vector)
The vector from which to extract a component. You can input a vector smaller than 4D, and if you ask for a component outside the range of the vector the Vector Node will output 0.0.

Component (Integer)
An integer value that specifies which component to extract from the vector. A value of 0 extracts the x component of the vector, 1 extracts the y component, and so on.

Vector Noise - Fractals

Outputs vector-valued samples of the chosen Noise. As with the Noise Node, the input dimension of this Node is driven by the domain Parameter. The size of the output vector is driven by the input Parameter to which the Vector Noise Node is connected.

Position (Real or Vector)
The point at which the Noise is to be evaluated.

Largest Feature (Real or Vector)
The size, in meters, of the largest features.

Offset (Real or Vector)
Moves the Noise around.

Result Scale (Real)
The amount by which the Noise value is multiplied before output.

Input Domain (Integer)
Defines the number of input dimensions. The Input Domain can be set to 1, 2, 3, or 4. Use 1D Noises for things based on altitude or slope. 2D Noises can be used inside Parameter bombs or in UV texture space. 3D Noises are generally used for everything else. The 4D Noises are generally used only in conjunction with the Time Node for special animation effects.

Basis Noise
Opens a DDLB that lists all available Noise Basis Functions.

Alphabetical Node List - W

World Position – Leaf Nodes
Outputs the coordinates of points in World Space. This is the single most commonly used Node, as it provides the point at which you generally want to evaluate the Textures applied to your MojoWorld.

Introduction to MojoTree

MojoTree allows you to load in preset vegetation or create your own new types of vegetation then distribute that vegetation procedurally across the surface of the MojoWorld planet. The MojoTree add-in package consists of the MojoTree.dll plug-in file and a library of presets. MojoTree is installed during the MojoWorld Pro installation.

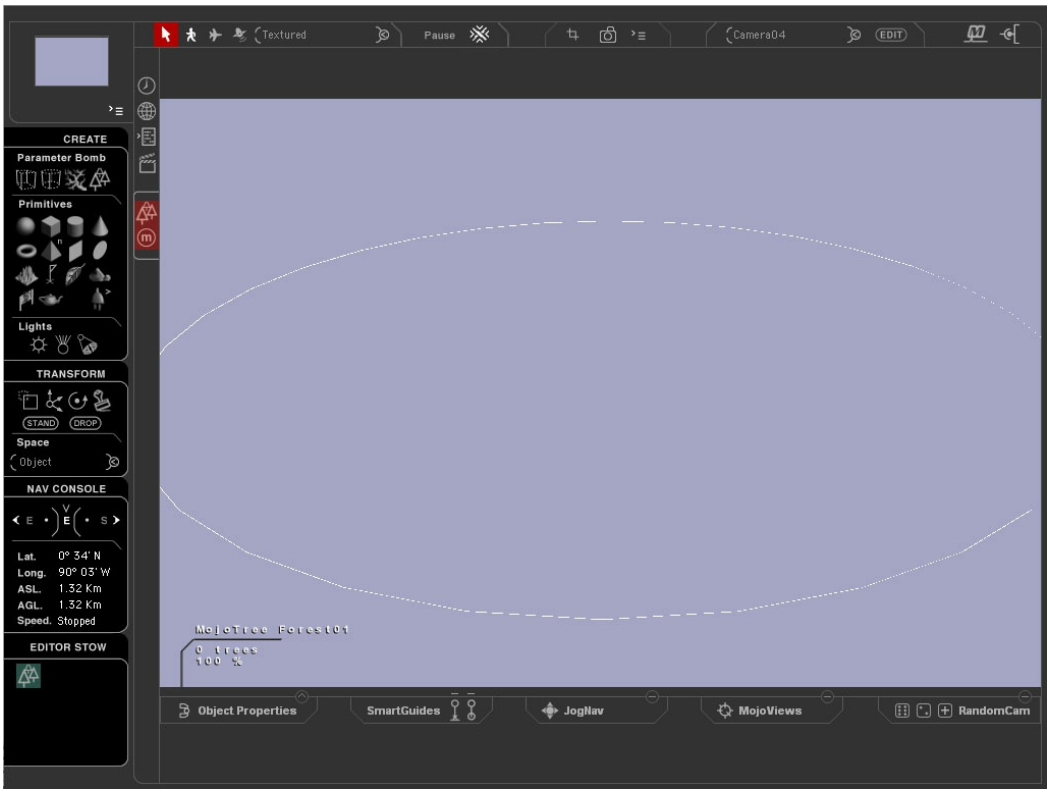
For installation instructions on how to add-in MojoTree to MojoWorld Standard, please see the additional installation information included with your MojoTree add-in serial number.

In this chapter, you will learn about:
• The three editors added by the MojoTree plug-in
• How to build a forest from preset trees in the Library and use the MojoTree Forest editor to control the distribution of those trees
• How to use the MojoTree Branches editor to define branch elements of your own trees
• How to create variety in a single tree's definition to build a forest of similar (but different) trees
• How to use the MojoTree Leaves editor to define leaf elements of your own trees

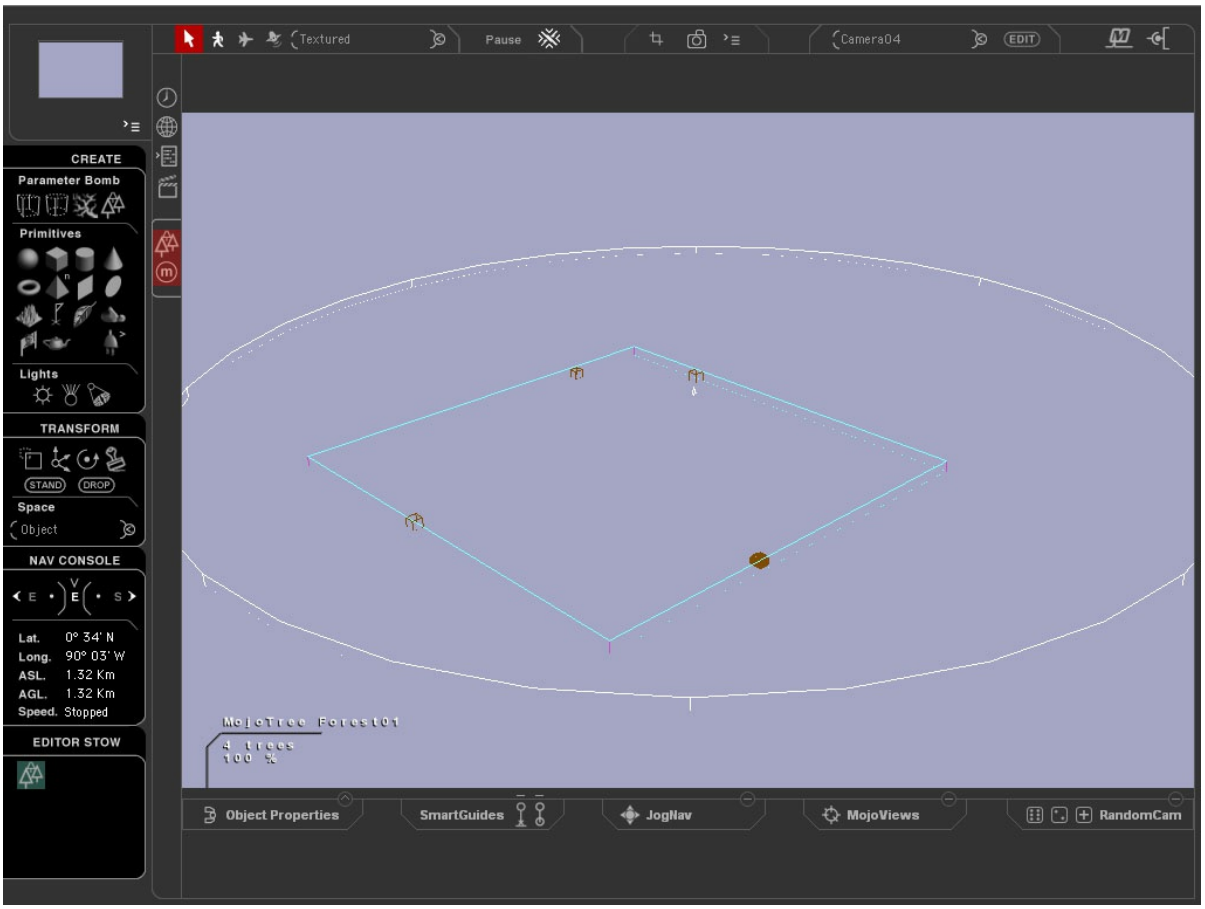
MojoTree Editors

The MojoTree plug-in adds three new editors to the Generator: the MojoTree Forest editor, the MojoTree Branches editor, and the MojoTree Leaves editor. The MojoTree Branches and MojoTree Leaves are the tools with which ‘plants’ are created or modified.

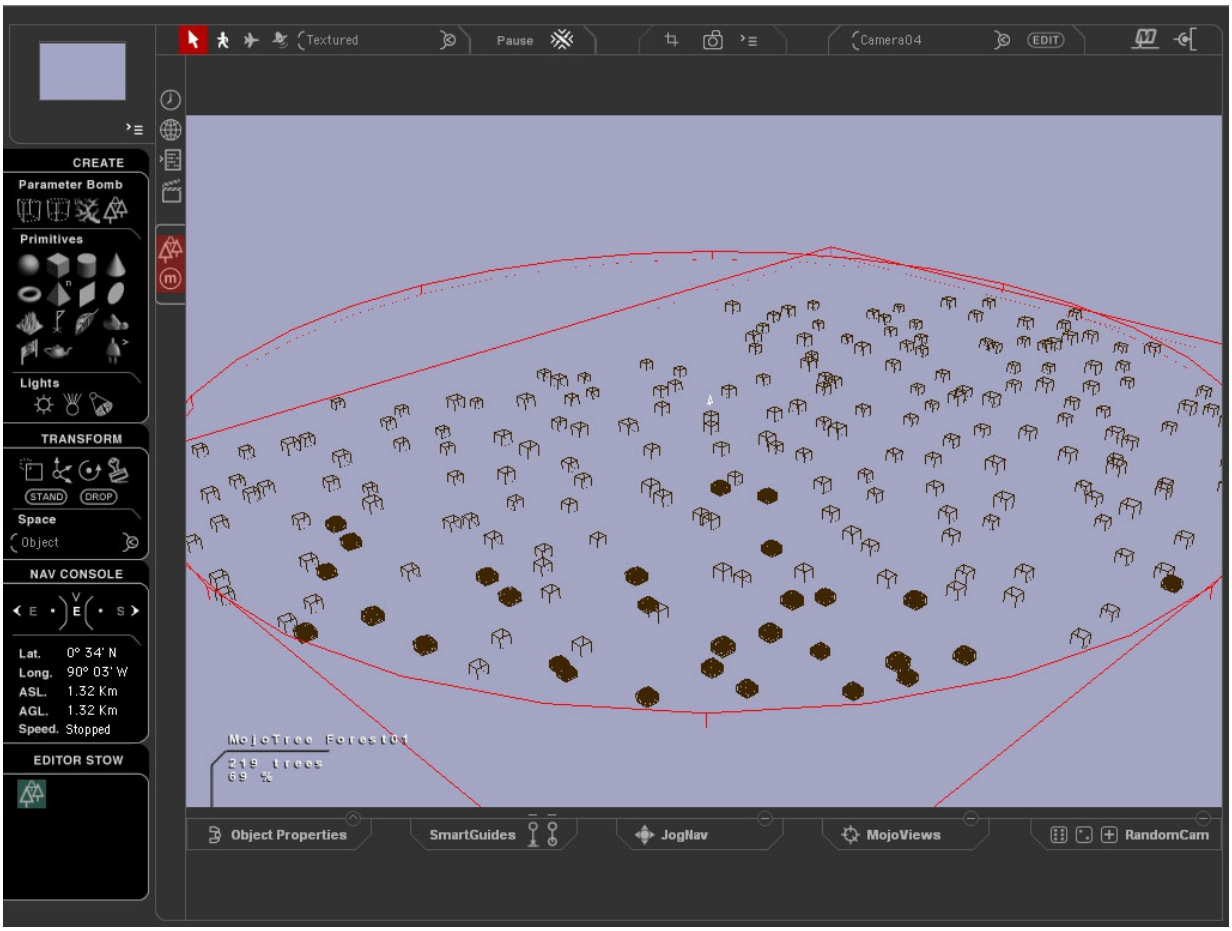
The MojoTree Forest editor is the tool used to distribute those plants across your MojoWorld planet.The MojoTree Forest has three different modes: a single tree mode, a local forest mode, and a global forest mode. The global forest in its current form exists only in a limited area surrounding the current camera as defined by the Clipping Distance parameter – anywhere you go on the globe, there will be forest, but it will always end at a finite distance from the current camera. This chapter will deal specifically with Local Forests and Single Tree Forests. For Advanced Global Forest Theory, see discussions on mojoworld.org. When a world with a complex forest is opened the forest may take quite some time to build itself. This building process is indicated in the RTR window by a variety of visual cues. The first is the interaction of the Forest bounding elements. These elements are represented by a white circle and a cyan (light blue) box. The white circle indicates the Clipping Distance of the forest. The cyan box represents the volume currently covered with trees, the Forest Bounding Box. During the forest building process, these two bounding elements will be shown in red. When the forest building is complete, they will change back to their white and cyan colors. When the forest is first created, it is a plain and flat white circle.



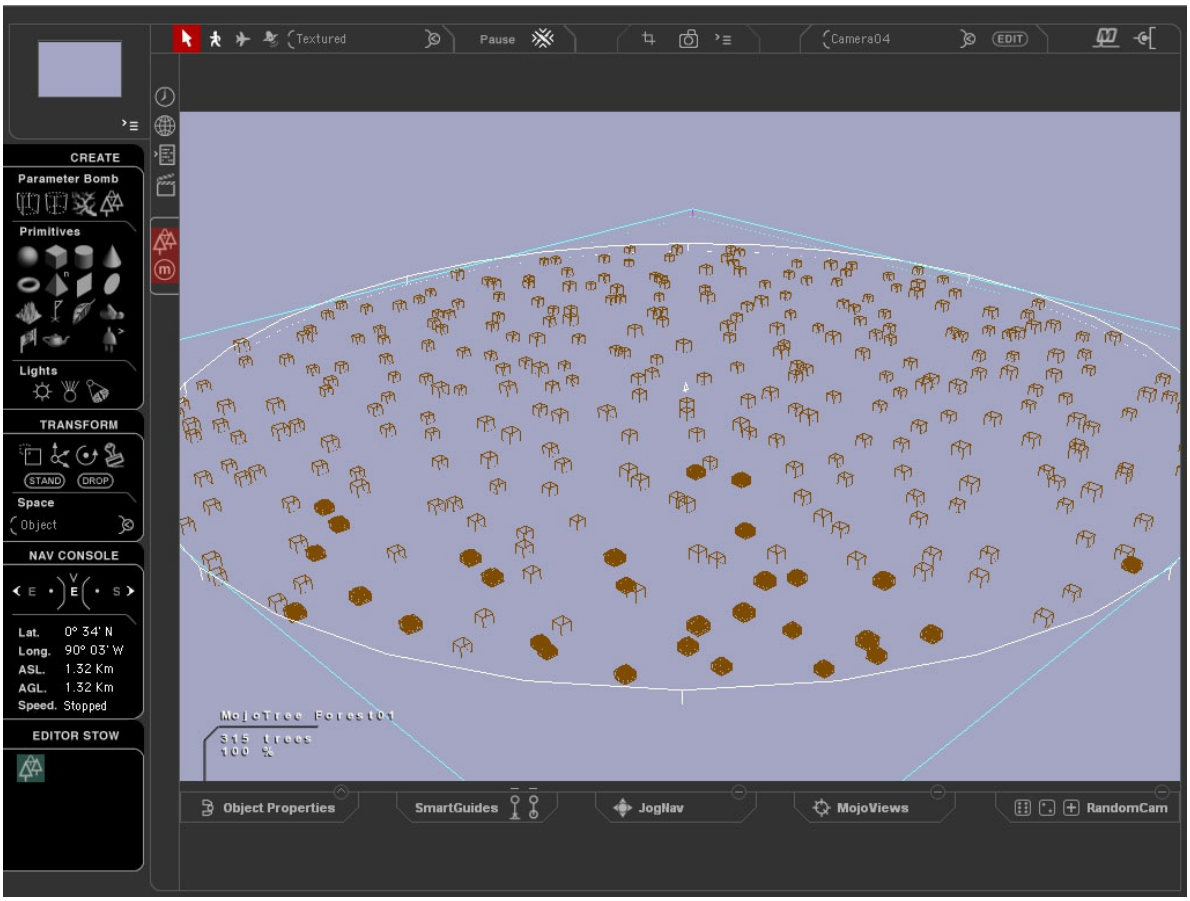
When the first trees appear, the Clipping Distance circle becomes a cylinder wireframe, where a second circle appears directly above the first circle at the height of the top of the tallest tree. The center point of the forest is represented by a wireframe arrow standing upright in the center of the cylinder. This center point indicator is not present for a Global Forest, as the center of a Global Forest is determined by the current camera's location.



Any trees that are present will be enclosed in the cyan box. For a Single Tree Forest, the Forest Bounding Box will fit to the size of the single tree it contains and there will be no Clipping Distance cylinder. The final size and location within the Clipping Distance Cylinder of the Forest Bounding Box for a Local Forest will depend on the tree density. If there is not a sufficient density of trees, no trees will appear and there will be no Forest Bounding Box. If there is at least one tree in the forest, the Forest Bounding Box will contain that one tree as well as the center point of the forest. As a complex forest grows and more trees appear, the box grows larger.



For a very dense forest, the largest possible size of the Forest Bounding Box will completely enclose the Clipping Distance cylinder, but usually, the box will mostly be within the cylinder. While the forest is growing, the box and cylinder are drawn in red. When the forest stops growing, the box and cylinder turn cyan and white, respectively.



The second visual cue you will see in the RTR when a forest finishes building is that the RTR representations of the individual trees will lighten.

A third cue on the status of Forest building is shown in the Object Properties. This readout shows the number of trees present in the forest and a percentage complete for the forest building.

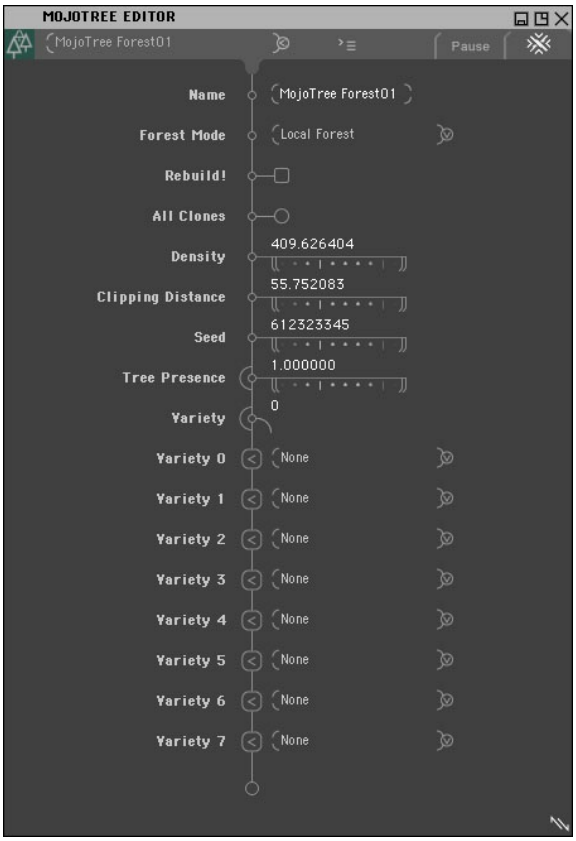
Tip

The forest will be rebuilt when any changes are made to the forest or any of its elements. If the world changes around the forest, however, you may need to tell the forest to rebuild itself via the punch button in the Forest control stack.

Forest Editor

MojoTree Forest Editor

The forest editor controls the distribution of the tree varieties.



Name

Use this string to uniquely identify your forest object.

Forest Mode

This DDLB specifies whether the forest is a Local Forest (the default), a Single Tree, or if it is a Global Forest.

Rebuild!

Click this punch button to tell the forest to recalculate itself.

All Clones

For a Single Tree forest, this is ignored. When this is enabled for a Local Forest or a Global Forest, all of the trees use the same geometry regardless of any textures used to give the trees variety.

Density
For a Single Tree forest, this is ignored. For a Local Forest or a Global Forest, this value is a maximum number of trees per square kilometer. However, due to the way trees are distributed based on the Seed value and any texture or function attached to the Tree Presence parameter, the actual number of trees per square kilometer will be less than the density.

Clipping Distance
For a single tree forest, this is ignored. For a Local Forest, the Clipping Distance defines the size of the local area. The Clipping Distance also affects a Global Forest. It defines the distance from the camera at which the forest no longer appears. A Global Forest covers the entire globe in that anywhere you set your camera there will be trees. However, the trees will only exist in an area defined by the Clipping Distance and the position of your current camera. The Clipping Distance is visually indicated in the RTR with a white cylindrical wireframe. The value for this parameter is in meters.

Seed
Use this number to base the random distribution of trees. Forests with the exact same Seed will place trees in the exact same places (before the Tree Presence parameter is taken into account).

Presence
This parameter decides whether a tree grows at a spot determined by the random seed. When the parameter is set to a constant 1 (the default), a tree appears in every spot determined by the seed value. With this parameter set to 0, no trees will appear. Driving this parameter with a texture can be used to keep trees from growing in the ocean and/or on slopes that are too steep, for example. See the first tutorial on Building a Forest from Library Items for a detailed example.

Variety
The variety slider controls which of the eight different varieties is used to construct the Forest. When the slider is set to a constant value, only plants of that variety will occur in the Forest. In order to have your Forest be constructed of more than one variety of plant, the Variety parameter must be driven with a texture. An example of this can be found in the Building a Forest from Library Items tutorial.

Variety 0 through Variety 7 Sub Plug-in Slots
Each of these eight sub plug-in slots behave the same way. The DDLB will show “None” when the Variety slot is unused. Variety slots with MojoTree objects in them will show the name of the root MojoTree object. The DDLB is separated into three sections. The top section provides options for managing the MojoTree objects. The second section is where new MojoTree Branches and new MojoTree Leaves are created. The third section lists all currently defined MojoTree Branches and MojoTree Leaves defined in the current world file. The options in the first section of the DDLB are:

None
All Variety slots default to None. Once a Variety slot has been populated, the name of the root MojoTree object will be shown on the closed DDLB. It can be set back to None at any time to remove the MojoTree from the Variety slot.

Delete
This option deletes the current object. If the current object is a MojoTree Branches object with Child objects, only the MojoTree Branches object will be deleted. Any Child objects will remain in the world file, regardless of whether they are connected to a

Forest object.

Load...
This option opens the MojoTree Library Importer dialog. Loading a MojoTree into the DDLB here will display the name of the MojoTree's root element on the closed DDLB.

Save...
This option opens the MojoTree Library Exporter dialog to save the currently selected MojoTree root element and all of its children.

Tidy Up...
After loading in several different MojoTree objects from the library, or creating several new MojoTree Branches and MojoTree Leaves objects, the bottom section of the Variety DDLBs can get quite crowded. The Tidy Up option will delete all MojoTree Branches and MojoTree Leaves objects which are not currently connected to a Forest object.

Building A Forest from Library Items

This tutorial introduces how to use the preset MojoTree library items in your own custom Local Forest. It also covers how to use the Tree Presence parameter to control where trees occur and how to use the Variety parameter to refine that control.

Open or create a MojoWorld planet with a non-flat land texture and an ocean. Ideally this world should have a simple land material. While MojoTree forests do take land material displacements into account, your test renders will go much faster for this tutorial if the world is simple.

Find a location for your Forest. It is recommended that your camera be at an altitude no more than 200 meters or so. Most trees are scaled somewhat larger than Earthly proportions, but even so, many of the tree presets will appear as tiny boxes when viewed from higher altitudes.

Select the Forest icon in the Parameter Bomb tools. Drag in the RTR to place the forest. A newly created forest is always of type Local Forest. As you drag to place the forest, you will see a red circle expand on the surface of your MojoWorld representing the Clipping Distance parameter. The circle will turn white when you release the mouse.

After the forest is placed, click the Forest Icon in the Hot Buttons area to open the Forest Editor. Name your forest “Tutorial Forest.” To load a tree preset, open the DDLB under Variety 0 in the Forest Editor and choose the “Load...” option. A Library Importer dialog will open to the Libraries/MojoTree folder. If the Home icon is displayed, click it to return to the MojoTree home library. Choose a MojoTree from the library and click OK.

You should now have a Local Forest populated with a single variety of trees. Depending on where you placed this forest, some of the trees may be located in spots which aren't necessarily places where trees would normally grow, such as in the ocean or on the sides of cliffs. We'll fix that by driving the Tree Presence parameter with a texture.

Change the Tree Presence parameter to a texture. In the new texture editor that opens, select 'New Texture' from the Texture Editor Options Menu. Name this new texture 'Tree Presence.' Enable the first texture leaf. Click it again to expand its kickstand.

Change its name to 'Avoid Water.' To make the trees avoid water, the Tree Presence texture needs to output 0 where the land altitude relative to the sea level is 0 or less, and it needs to output 1 where the land altitude relative to the sea level is larger than 0. Change the Input Coordinate on this Texture Leaf to Altitude and check the 'Use Sea Level?' box on the Altitude node. We want to use just the raw altitude, not an altitude-based fractal, so set the main fractal to None. The default Input Curve in the Output Controls is already set up to output 0 or less where the land altitude is 0 or less, and to output 1 or more where the land altitude is 1 or more. That will allow trees to appear right up to the water's edge. We'll go into the Input Curve and change the Min Input and Max Input to not only keep the trees out of the water, but to also keep them off the beach. For example, setting the Min Input to 100 and the Max Input to 110 will keep the trees from growing on land that is 100 meters above the sea level.

To address the issue of trees growing on cliffs, create a second texture leaf in the Tree Presence texture. Name this leaf 'Avoid Cliffs.' Remember that a slope of 1 is flat and a slope of 0 is a vertical cliff. This leaf should output 0 where the slope of the land texture is less than 0.85 or so, and it should output 1 where the slope of the land texture is more than 0.9. Set the Input Coordinate to 'Slope' and set the main fractal to 'None.' Select the Output Controls and open the Input Curve. Set the Min Input to 0.85 and set the Max Input to 0.9. Click OK to close the curve editor.

The last change to make in the Tree Presence texture is to change the blend from ‘Maximum’ to ‘Minimum.’ Your forest now will not grow on cliffs or in the water.

The forest still consists of only one type of tree. Open the Variety 1 DDLB and choose the “Load...” option. Select a MojoTree from the Library Importer and click OK. Now two variety slots are filled, but the forest in the RTR does not appear any different. No Variety 1 trees are visible. This is because of the Variety parameter. It is currently set to a constant 0, which means that only Variety 0 trees are present. Change the Variety slider to 1 and now only Variety 1 trees will be present. Change the slider to a value larger than 1 and no trees are present, because the Variety 2 through Variety 7 sub plug-in slots are all currently set to “None” and therefore are all empty of MojoTrees. To make the forest have both Variety 0 and Variety 1 trees in it, the Variety parameter must be driven with a texture.Change the Variety parameter to a texture. In the new texture editor that opens, choose ‘New Texture’ on the Texture Editor Options Menu. Name the new texture, ‘Tree Variety.’

Enable the first texture leaf and open its kickstand. Change its name to ‘Tree Variety’ as well.

The Tree Variety texture we’ll use here is set up in World Position coordinates. Using a Noise instead of a Fractal is often a better choice, both for speed concerns and for a ‘cleaner’ distribution, so change the Monofractal to Noise. Depending on the size of your Local Forest, the default Largest Feature of this texture leaf’s Noise will probably need to be made smaller. For example, if the Clipping Distance of your forest is 900 meters, the default Noise LFS of 1000 meters will likely result in a predominance of one variety over the other, where setting the LFS to 100 instead will result in more of a mix. The other change needed for this texture leaf to make it suitable for distributing tree varieties is to adjust its output range. By default, the output ranges between -1 and 1, but for our tree distribution, it should range between 0 and 1. Open the Input Curve and change the Min

Input to -1 but leave the output values as they are to get the 0 to 1 range. This will remap the Noise's -1 to 1 output onto the 0 to 1 range.

For forests which will consist of more than two varieties, the Variety texture will need to output a wider range of values. The minimum will always be zero and the maximum will be equal to the largest Variety sub plug-in used. If you leave one of those sub plug-ins empty, where the Variety texture outputs a value that would normally result in a tree of that variety, no tree will appear. For example, if you have tree elements defined in the Variety 0, Variety 1, and Variety 4 sub plug-in slots, the Variety texture will need to output values between 0 and 4, and where the Variety texture outputs values of 2 or 3, there will be no trees.

Combinations of textures on the Variety parameter and the Tree Presence parameter can create some very complex tree distributions. See the MojoTree sample worlds folder for some examples.

Creating Trees

Trees are made up of two different tree elements. Both of these elements can be elaborately shaped and positioned to create trees from the realistic to the fantastic, and can even create trees that are not trees at all, such as buildings!The two tree building blocks are the MojoTree Branches object and the MojoTree Leaves object. Each has its own editor with its own parameter set. The MojoTree Branches object may have child objects associated with it that can be of either the Branch or Leaf type.

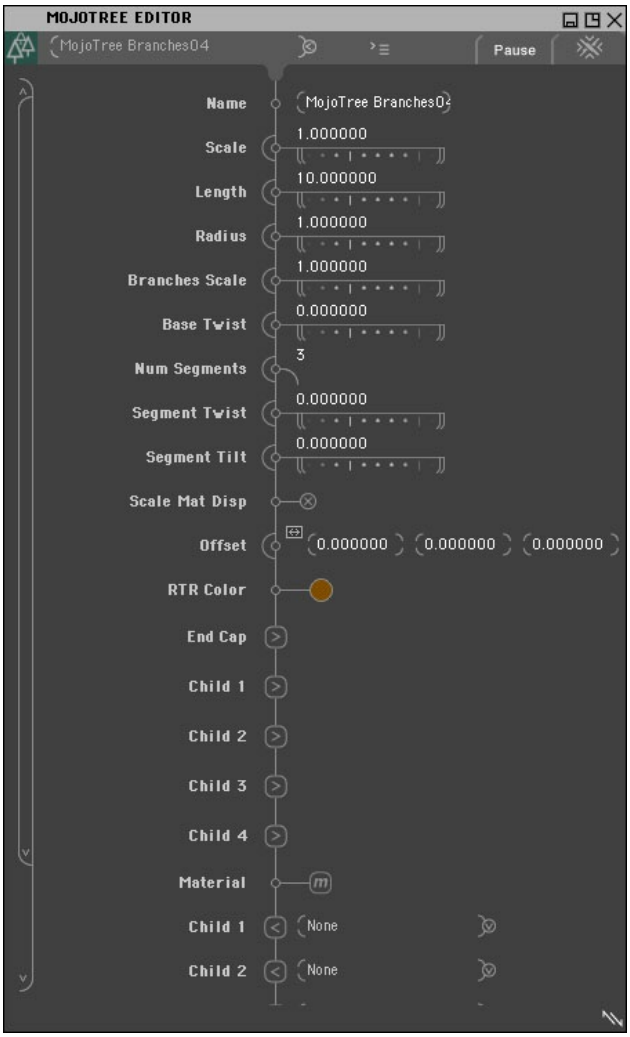
Tutorials for this section of the chapter are:
• Shaping MojoTree Branches

• Using MojoTree Branches Child Groups

• Creating Variety With Texture-driven Parameters

MojoTree Branches Editor

This editor is used to shape the MojoTree Branches object and to control the number, type, and distribution of any Child elements.



Name
Use this string to identify the various Branches objects from which you build plants. It is highly recommended that you give Branches meaningful names. Another important recommendation is that the name you give to the ‘base’ element of your tree is in all UPPER CASE (which is a convention followed by the included content.) This makes it easier to find which element should be used as the various

Variety sub plug-ins on the Forest Editor.

Scale
An overall factor by which the Branch and all of its children are scaled. This parameter can be driven by a texture to create variety in the plant sizes. An example of this can be found in the Creating Variety tutorial.

Length
This value specifies how long the branch is in meters when the Scale is set to 1. The default is 10 meters. Driving this parameter with a texture can be used to create variety in the plants. An example of this is covered in the Creating
Variety tutorial.

Radius
This specifies the radius of the branch in meters when the Scale is set to 1. The default is 0.5 meters. The effects of the Radius parameter are not visible in the RTR preview. A common texture found on the Radius parameter is used to taper the branch. Examples can be found in the Shaping MojoTree Branches tutorial and in the Creating Variety tutorial.

Branches Scale
An amount by which the child branches will be scaled. Driving this parameter with a texture based on the U coordinate of the UV Position can be used to create branches which get smaller toward the tip of the tree. An example of this can be found in the Using MojoTree Child Groups tutorial.

Base Twist
The number of degrees which the base of the branch should be twisted. The range is limited to -180 to 180 degrees. The effects of this parameter may not be apparent if there is no tilt to the branch. An example of the effects of this parameter will be shown in the Creating Variety tutorial.

Num Segments

The number of segments in the branch. A branch must have at least one segment. The effects of multiple segments may not be apparent if there is no twist and/or tilt to the segments. Examples of this parameter will be shown in the Shaping MojoTree Branches tutorial.

Segment Twist
The number of degrees which individual segments should be twisted. The range is limited to -180 to 180 degrees. The effects of this parameter will not be apparent if there is only one segment to the branch or if there is no tilt to the segments. Examples of this parameter will be shown in the Shaping MojoTree Branches tutorial.

Segment Tilt
The number of degrees which individual segments should be tilted. The range is limited to -180 to 180 degrees. The effects of this parameter may not be apparent if there is only one segment to the branch. Examples of this parameter will be shown in the Shaping MojoTree Branches tutorial.

Scale Mat Disp
When checked, any material displacements applied to the branch are scaled with the branch. If unchecked, the material displacements may adversely affect the shape of the branch.

Offset
A 3D vector by which the base of the branch will be offset. The most common exampleof this would be to specify an offset of (0, 0, -1) to sink the base of the branch 1 meter into the ground.

RTR Color
Use this to help identify your branches in the RTR preview window.

End Cap Control Stack
The parameters on this control stack affect the presence and shape of the cap at the end of the branch. Examples of the End Cap are shown in the Shaping MojoTree Branches tutorial.

Active
When checked, these branches will have closed ends. If disabled, these branches may appear to be hollow tubes, if their radius is non-zero at the tips.

Curvature
The default value for Curvature is 1.0 which specifies a convex hemisphere as the end cap. A value of 0.0 creates a perfectly flat end cap. A value of -1.0 creates a concave hemisphere. Values larger than 1.0 or smaller than -1.0 will be stretched hemispheres.

Child 1 through Child 4 Control Stacks

These control stacks affect the distribution and orientation of the child branches. Parameters on these control stacks have no effect if the associated Child sub plug-in is empty. A Child may be a Branch or a Leaf. These parameters will have examples in the Using MojoTree Branches Child Groups tutorial.

Group Size
This specifies the number of child objects per group. The maximum is 32.

Base Twist
The number of degrees which the base of the Child branch or leaf should be twisted. The range is limited to -180 to 180 degrees. The effects of this parameter may not be apparent if there is no tilt to the Child branch or leaf.

Group Twist
The number of degrees which the entire Child branch or leaf group should be twisted. The range is limited to -180 to 180 degrees. The effects of this parameter may not be apparent if there is only one Child group.

Group Radial Distribution
The number of degrees over which the group of Child branches

or leaves should be fanned. The range is limited to -360 to 360 degrees. The default is 360, causing the Child group to fully surround the parent branch. For example, if the Group Size is 4, a Child branch or leaf will appear at 0, 90, 180 and 270 degrees. If the Group Radial Distribution is lowered to 180, those same four Child objects will appear at 0, 60, 120 and 180 degrees. If the Group Radial Distribution is lowered to 90, those same four Child objects will appear at 0, 30, 60, and 90 degrees.

First Group Position
A value between 0 and 1 specifying where the first group of children appears. If set to 0, the first group of children will appear at the base of the parent branch. The default value is 1.0 which puts a single Child group at the very tip of the branch.

Group Axial Spacing
This value specifies the distance between Child groups. The parameter cannot be set any smaller than 0.01. Example: If the First Group Position is set to 0.5 and the Group Axial Spacing is set to 0.1, then Child groups will appear at the 0.5, 0.6, 0.7, 0.8, 0.9 and 1.0 positions along the parent branch.

Branch Tilt
The number of degrees which the Child branch or leaf should be tilted. The range is limited to -180 to 180 degrees. A Branch Tilt of 90 or -90 degrees sets the Child perpendicular to the parent. A Branch Tilt of 0 degrees aligns the Child parallel to the parent. A Branch Tilt of 180 or -180 degrees folds the Child into the parent.

Enable
This checkbox allows you to temporarily turn off the Child branch and all of its children. This affects the appearance in the RTR and in the fully rendered scene.

Branch Origin Offset
When the Branch Origin Offset is set to 0.0, the child object attaches at the center axis of the parent Branch object. The units

of Branch Origin Offset are in Branch Radii, so by setting the Branch Origin Offset to 1.0, the child object will attach one radius out from the center axis of the parent branch.

Material
This opens a Material Editor with which to define the material applied to the branch.

Child 1 through Child 4 Sub Plug-in Slots
Each of these four sub plug-in slots behave the same way. The DDLB will show “None” when the Child slot is unused. Child slots with MojoTree objects in them will show the name of the MojoTree object. The DDLB is separated into three sections. The top section provides options for managing the MojoTree objects. The second section allows you to create a new Branch or Leaf object to use as the Child. You may also select from any Branch or Leaf objects already loaded into the MojoWorld planet file listed in the third section of the DDLB. The options in the first section of the DDLB are:

> **None**
> All Child slots default to None. Once a Child slot has been populated, the name of the MojoTree object will be shown on the closed DDLB. It can be set back to None at any time to remove the MojoTree from the Child slot.
>
> **Delete**
> This option deletes the current object. If the current object is a MojoTree Branches object with Child objects, only the MojoTree Branches object will be deleted. Any Child objects will remain in the world file, regardless of whether they are connected to a Forest object.
>
> **Load...**
> This option opens the MojoTree Library Importer dialog. Loading a MojoTree into the DDLB here will display the name of the MojoTree’s root element on the closed DDLB.

Save...
This option opens the MojoTree Library Exporter dialog to save the currently selected MojoTree root element and all of its children.

Tidy Up...
After loading in several different MojoTree objects from the library, or creating several new MojoTree Branches and MojoTree Leaves objects, the bottom section of the Child DDLBs can get quite crowded. The Tidy Up option will delete all MojoTree Branches and MojoTree Leaves objects which are not currently connected to a Forest object.

Introduction to Tree Building

In the first MojoTree tutorial, we created a Local Forest, loaded in preset MojoTrees, and put textures on both the Tree Presence and Variety parameters to control the tree distribution.

This tutorial will introduce the basic concepts of how MojoTrees are made. The recommended working environment for creating new MojoTrees is to start in a completely empty world by using the File>New. Next, use the 2m button on the JogNav to drop the camera to the ground. Click the MojoTree icon then click on the ground in front of the camera. Open the MojoTree Forest Editor by clicking on its hot button. Set the Forest Mode to 'Single Tree' then set the Variety 0 sub plug-in to a new MojoTree Branches object. This will create a single tree consisting of a default MojoTree Branches object.

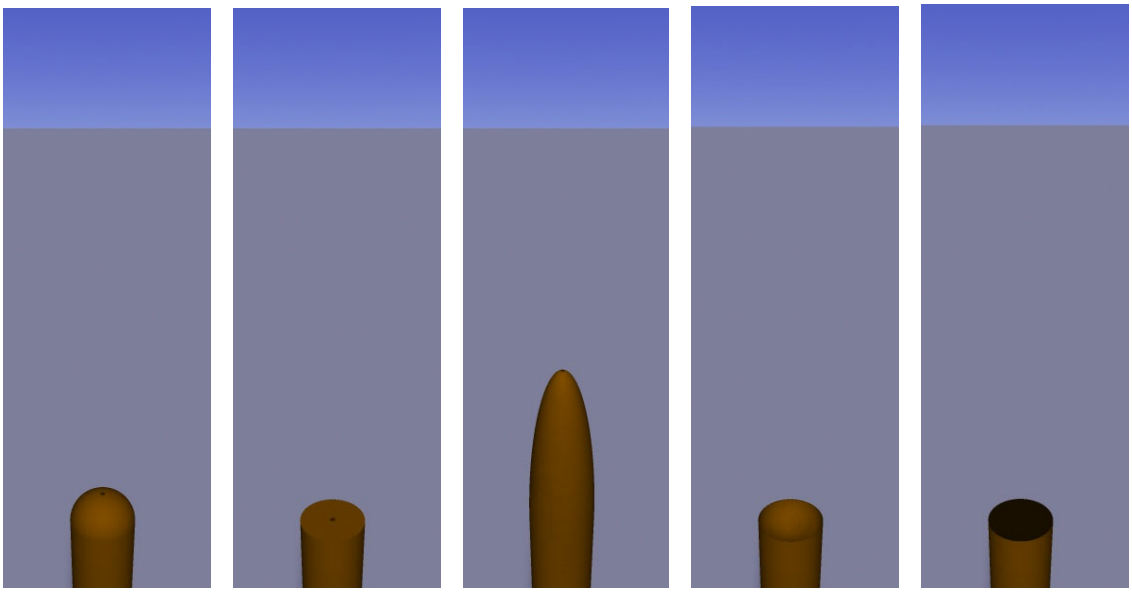
Depending on where you clicked to place the forest, you may need to move your camera back a little bit, as the default MojoTree Branches object is 10 meters tall. Compare this to a small bush, which may be only half a meter tall, or to a giant redwood tree, which often can grow to be close to 100 meters tall. Earthly trees are limited by gravity as to how tall they grow, but there are no such restrictions in MojoWorld. These common tree sizes are mentioned just to give you a rough idea of the scale.

The next few tutorials will cover how to shape MojoTree Branches, how to use the Child Groups of the MojoTree Branches, and how to introduce variety into your MojoTree creations. More advanced features of tree shaping will be covered at mojoworld.org.

Shaping MojoTree Branches
Start with a brand new file as described above, with a single tree forest in it consisting of a single Variety of a default MojoTree Branches element in the Variety 0 slot. Click the Editor button to the left of the Variety 0 DDLB to open the Branches Editor. Name this

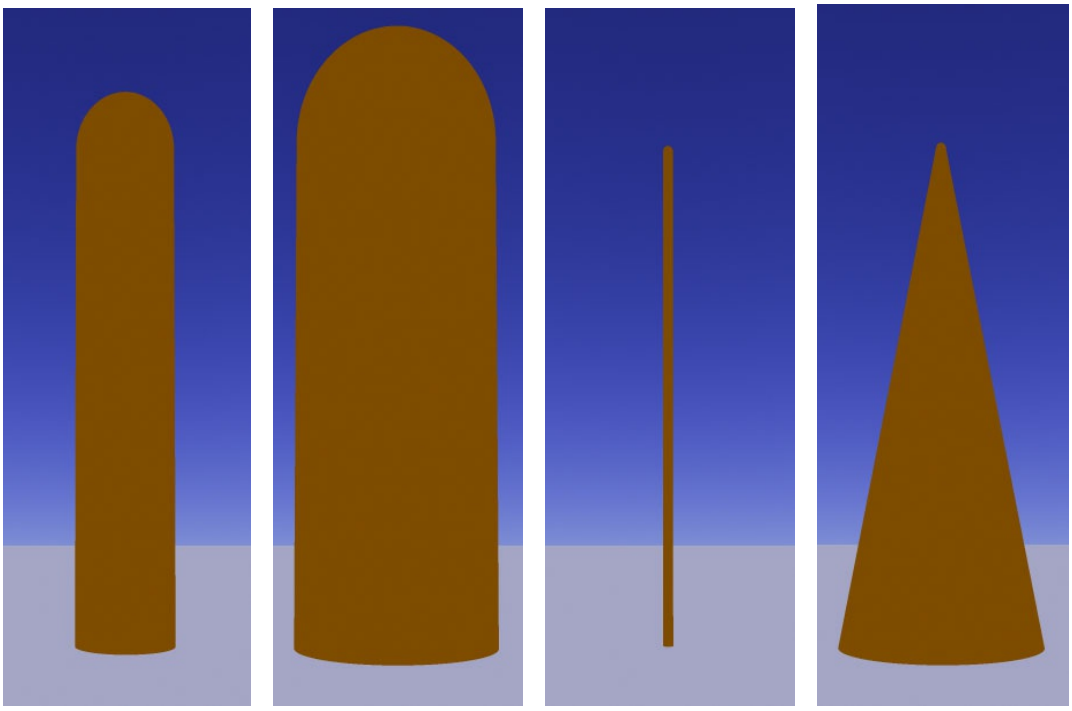
Branches object ‘Branches Shaping Test.’We’re going to start at the end – the End Cap. An important note about the End Cap relates to the UV coordinates of the Branches object. Many of the textures used to shape the Branches object rely on the U coordinate of the UV Position input. The End Cap’s U coordinate starts at 1 and continues on to 2 at the apex of the hemisphere. This will become clearer shortly, when we control the Branches object’s Radius parameter with a texture in UV Position input.

The effects of the End Cap parameter are not visible in the RTR preview, so the Branches object must be rendered to see the effects of changing this parameter. The End Cap is enabled by default. Un-check the checkbox to turn the End Cap off. The default Curvature of the End Cap is 1 which shapes the cap as a sphere with a radius equal to the Radius of the Branches object at its tip. Larger Curvature values create an elongated End Cap. A Curvature of 0 creates a flat End Cap. Negative Curvature values create an End Cap that is concave. The following images show the default End Cap with a Curvature of 1, a flat End Cap with a Curvature of 0, an exaggerated End Cap with a Curvature of 5, a convex End Cap with a Curvature of -1 and a disabled End Cap.

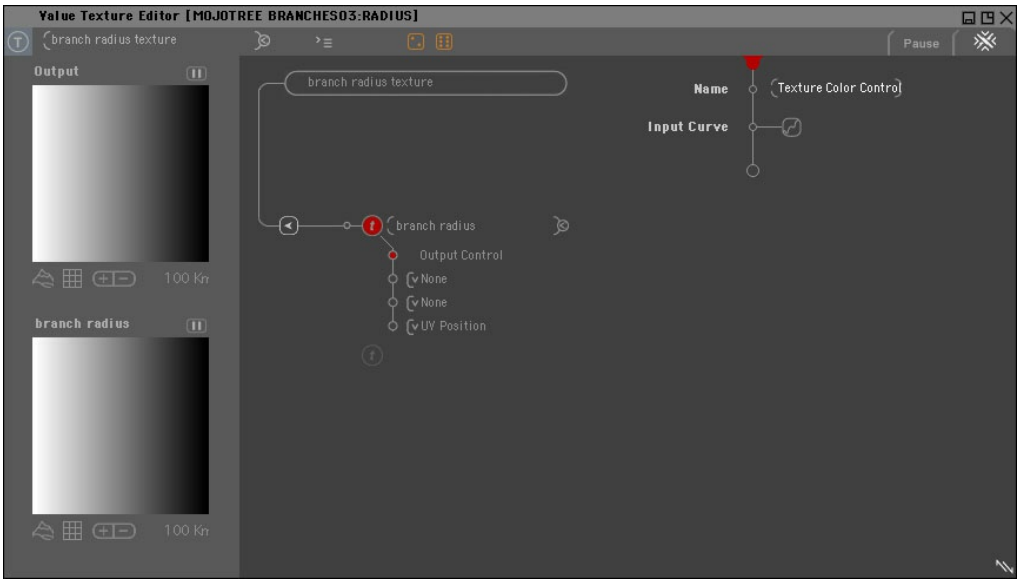


Next we’ll look at the Radius parameter. The Branches Radius

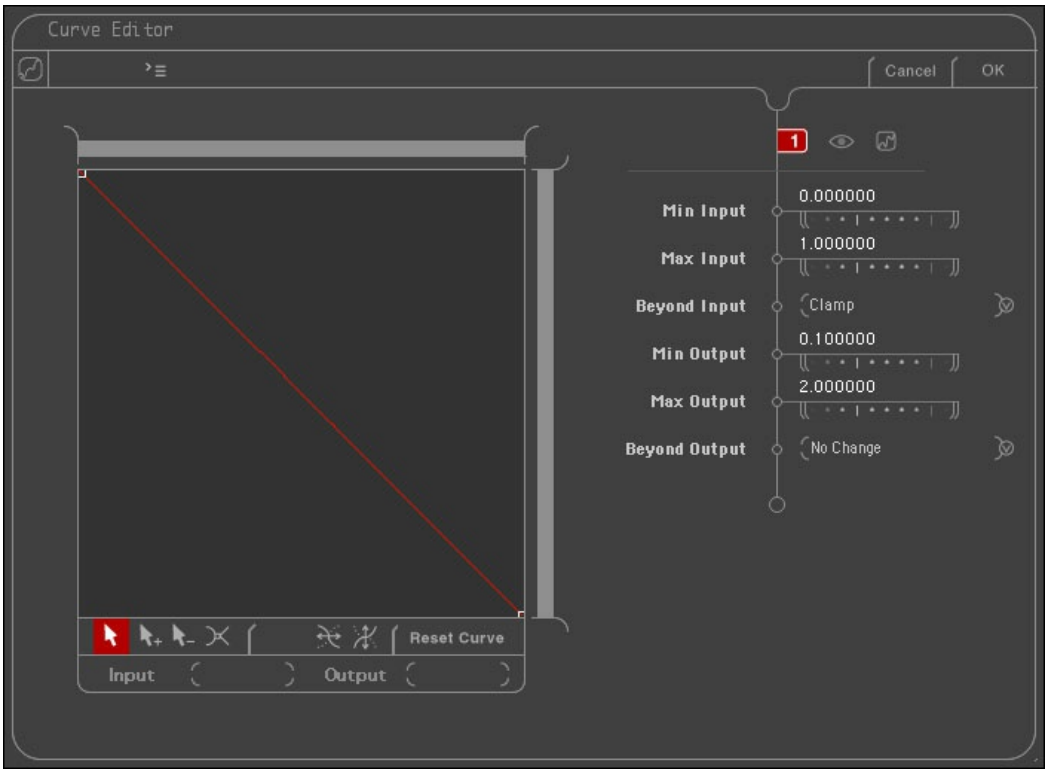
parameter controls how thick the rendered Branches objects are. The effects of the Radius parameter are not visible in the RTR preview, so the Branches object must be rendered to see the effects of changing this parameter. The following renders show the default MojoTree Branches object with its Radius set to 1 meter (the default), to 2 meters, to one-tenth of a meter, and a Radius driving by a simple branch-shaping texture:



Let’s look in detail at the simple texture used to create that last branch shape. The texture has a single texture leaf, with no fractals used in the kickstand, and the input coordinates at the tail of the kickstand set to UV Position. When there is no fractal in a texture leaf of this type, only the U coordinate is considered. The U coordinate of a Branches object is a value which ranges from 0 at the base of the branch to 1 at the top of the branch, where it then continues from 1 to 2 on the End Cap, if enabled.



To see how this texture really works, we must look at the Input Curve.



There are two important elements to note in this curve. The first is that the Beyond Input DDLB is set to ‘Clamp.’ This means that only the range of 0 to 1 (the Min Input to Max Input range) for the U coordinate of the branch will be affected by the curve. If the Beyond Input DDLB

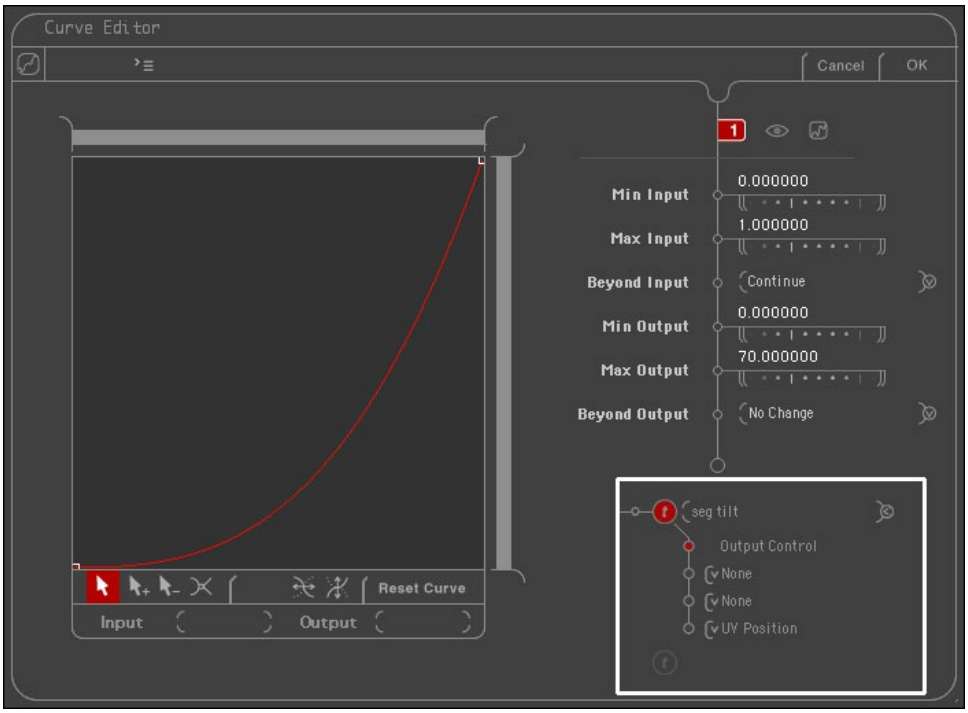
had not been set to ‘Clamp,’ then the End Cap would be adversely affected. The second important element of this curve editor is that the curve is inverted. This causes the resulting Radius to be equal to the Max Output at the base where the U coordinate is 0, and makes the Radius equal to the Min Output at the top where the U coordinate is 1. Another way that the Radius parameter can be textured is with a texture defined in World Position coordinates. This will be demonstrated in the Creating Variety tutorial.

The next set of parameters we’ll examine work together. They are: Num Segments, Segment Twist and Segment Tilt. The default number of segments is 3, but this isn’t apparent until the Segment Tilt is set to something other than zero. This next series of images show the wireframe of a default Branches object with the Segment Tilt set to 0 (the default), to 20 degrees, and to 50 degrees.

The previous wireframe images all use the default 3 in the Num Segments parameter. These next two wireframe images are of a Branches object with 20 segments. The first has the Segment Tilt set to 2 degrees and the second has the Segment Tilt driven with a simple texture.

The texture driving this last Segment Tilt parameter is set up very similarly to the texture for the Radius parameter. It is a single Texture Leaf with no fractals used in the kickstand and the input coordinate at the tail end of the kickstand is set to UV Position. The Curve Editor is where the bulk of the work is done.

The texture leaf is shown in an inset as a reminder:

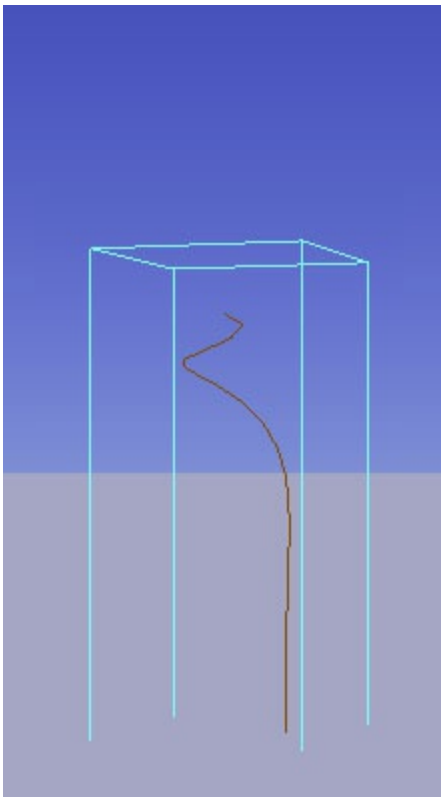


Remember that the input to the curve is the U coordinate of the Branches object, which ranges from 0 at the base to 1 where the End Cap appears and continues to 2 at the top of the End Cap. Because the End Cap is not segmented, the effect of the curve between 1 and 2 is not problematic as it was for the Radius parameter. This Curve causes the Segment Tilt to be 0 where the U coordinate of the Branches object is 0, and gradually increases the Segment Tilt as it moves up the Branches object, to a maximum of 70 degrees at the tip of the Branches object.

Another way that the Segment Tilt parameter can be textured is with a texture defined in World Position coordinates. This will be demonstrated in the Creating Variety tutorial.

The Segment Twist parameter is only apparent when there are multiple segments and those segments are tilted. If there is only one segment or if there is no tilt to the multiple segments, the Segment Twist appears to have no effect.

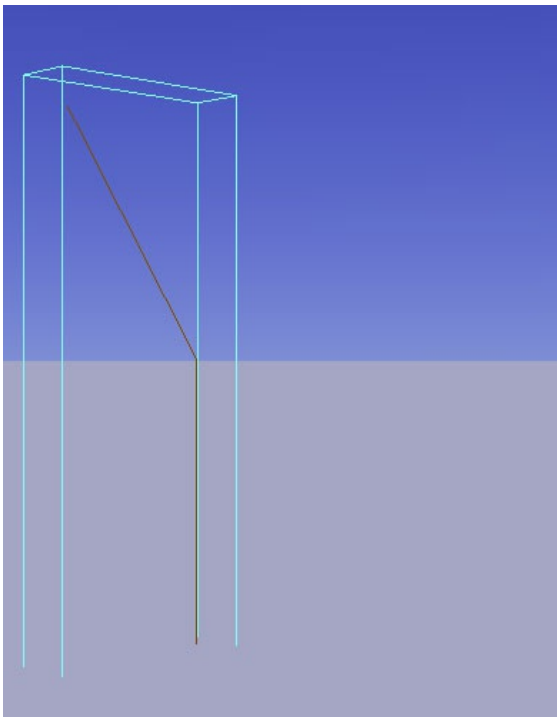
Combinations of these parameters can create complex shapes.



Using MojoTree Branches Child Groups

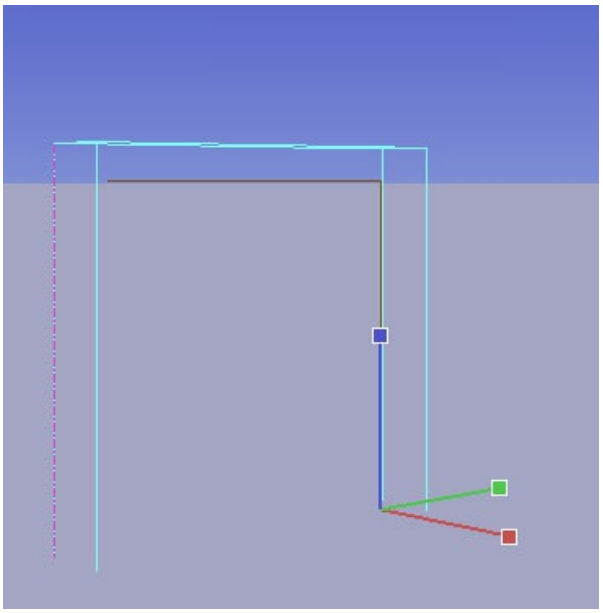
While you can make some very interesting and complex shapes with just a single segmented branch,
the really interesting plant-like structures come when you start adding Child Groups to your branches. This
exploration of Child Groups will start with a default Branches object, so if you're still working in the previous world where we looked at shaping Branches, just set the Variety 0 to a new MojoTree Branches object to start fresh.

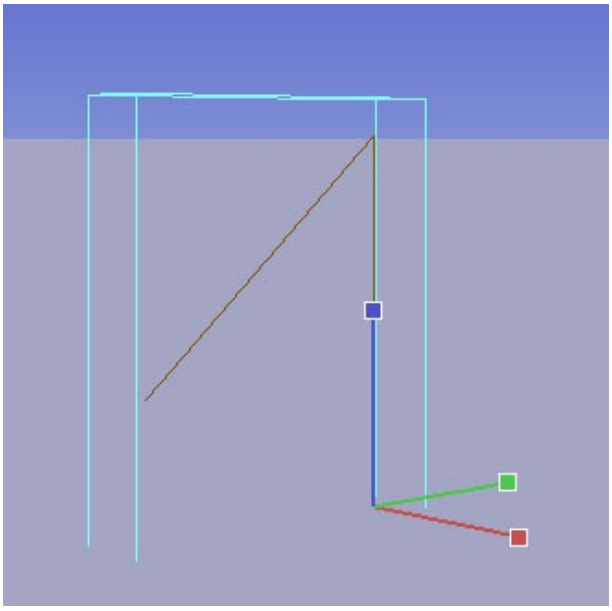
In the Branches Editor for the new default Branches object, set the Child 1 DDLB to yet another new MojoTree Branches object. Now before things get too crazy, set the name of the current Branches object to 'TRUNK' and then click the Editor button to the left of the Child 1 DDLB to open a second Branches Editor for the Child Branches
object and name it 'Child Branch.' Close this Branches editor and return to the Branches editor for the TRUNK object. The parameters we'll be examining are in the Child 1 Control Stack expansion of the TRUNK object's editor.
Here's what your tree will look like in the RTR:



The angle between the TRUNK and Child Branch comes from the Branch Tilt parameter in the first Child parameter control stack. These next two show the Branch Tilt set to 90 and to 135 degrees. The next wireframes have the Branch Tilt set back to 35 and the Group Size parameter set to 2, 3, 5, and 32.

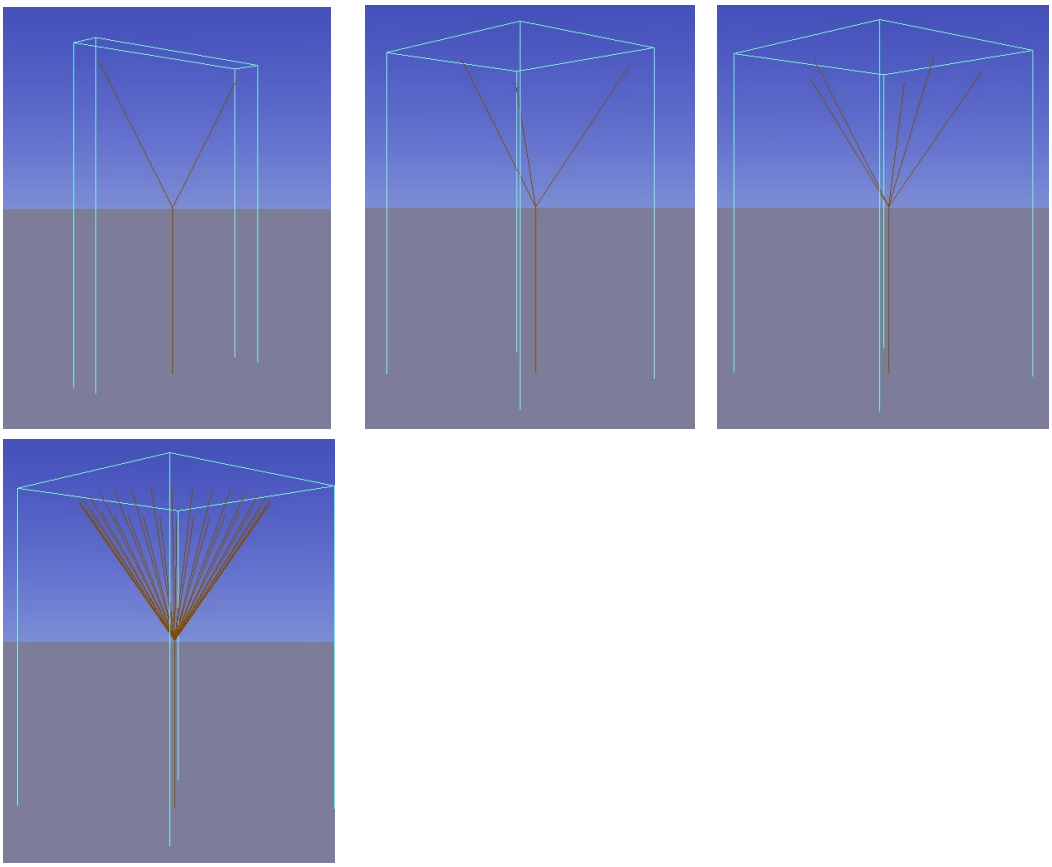
The default is to evenly space the children of the group around the parent Branches object.





Branch Tilt set to 90 degrees

Branch Tilt set to 135 degrees



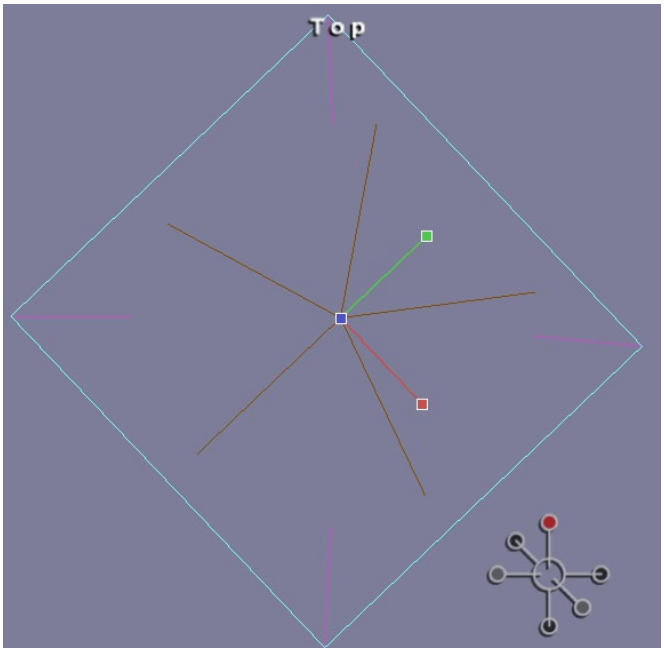
Branch Tilt set to 35 degrees, Group Size parameter set to 2, 3, 5, and 32

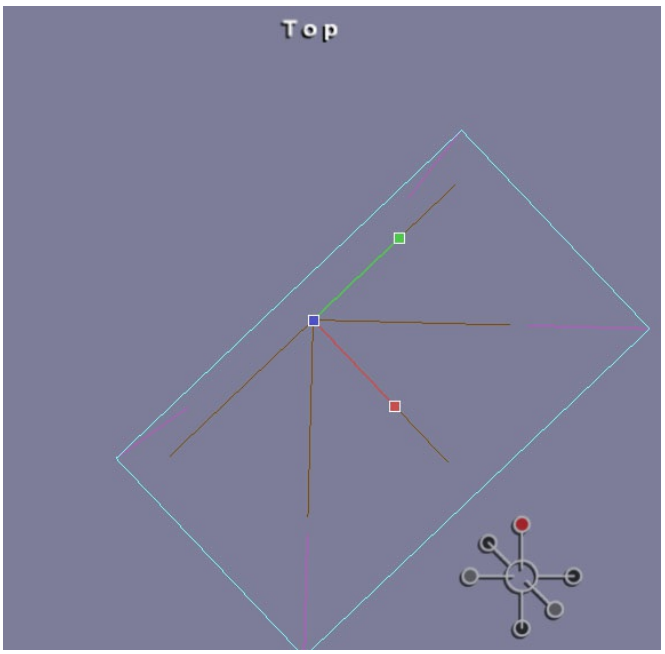
This can be changed with the Group Radial Distribution dial. While the Group Radial Distribution dial goes to a maximum of 360 or a minimum of -360, there may not be a visible effect above the value which evenly distributes the child objects. For example, with a Group Size of 2, values over 180 for Group Radial Distribution act as if the dial
is set to 180, since that places the two child objects at 0 and 180, evenly distributing them around the parent Branches object. The following screenshots were taken in the Top view of the MojoViews tool. They show the previous tree with a Group Size of 5 and the Group Radial Distribution set to 360, 180, 90, and 45.

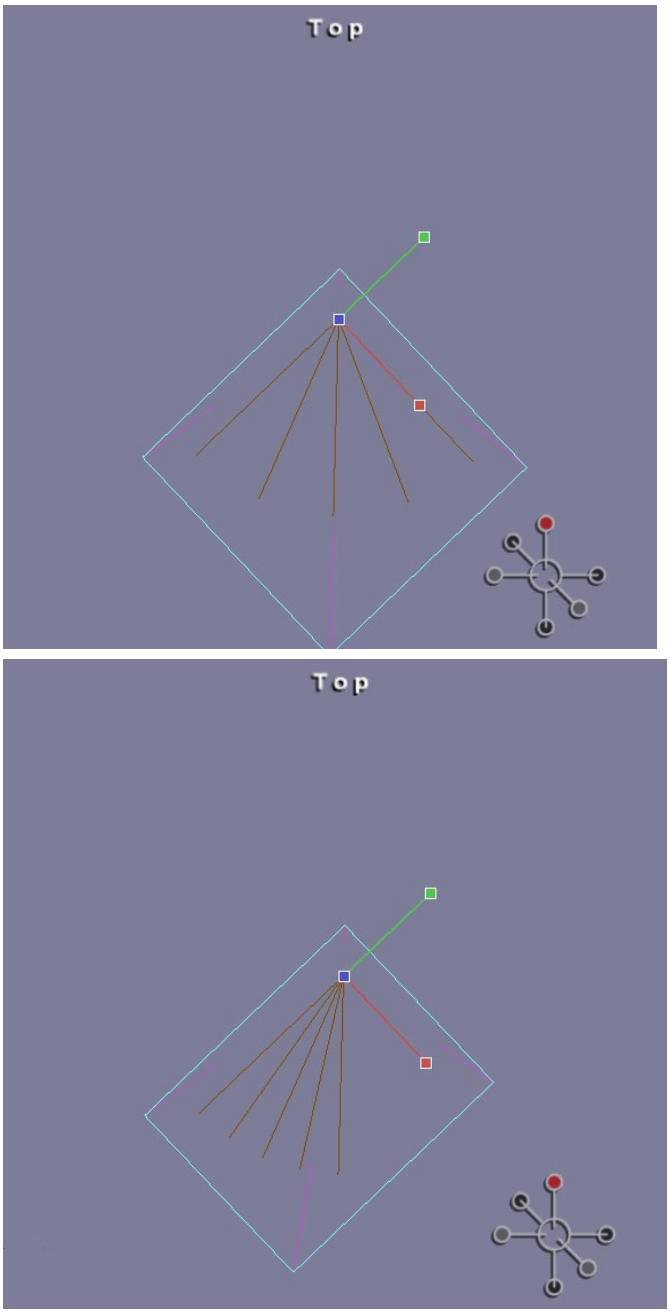
Note that if you set Group Radial Distribution to 0, all child objects of the current group will be put in the same place, thus making it appear as if the Group Size is set to 1 regardless of how many branches are

supposed to be in the Child Group!

The next parameters we'll look at are First Group Position and Group Axial Spacing.

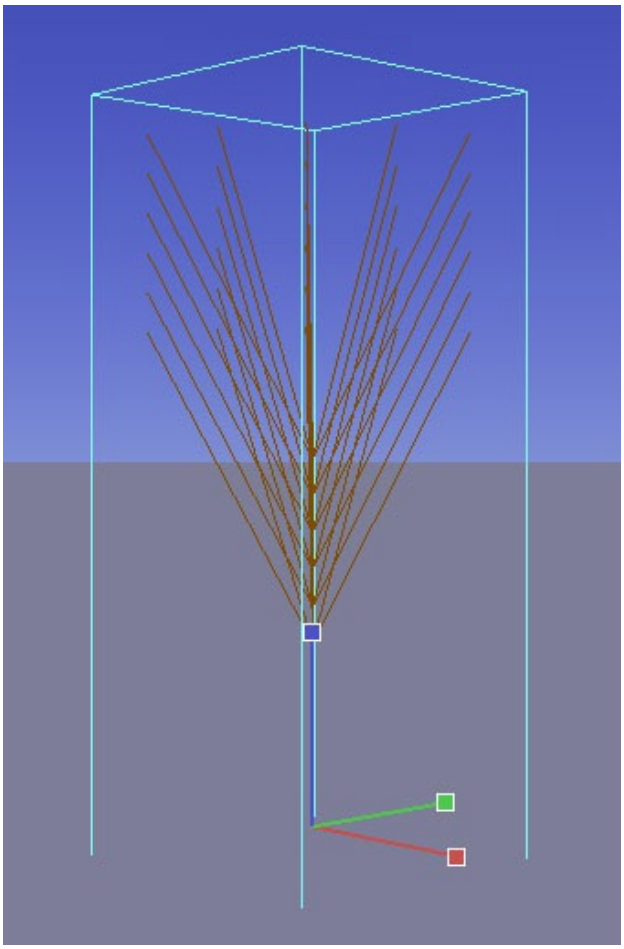






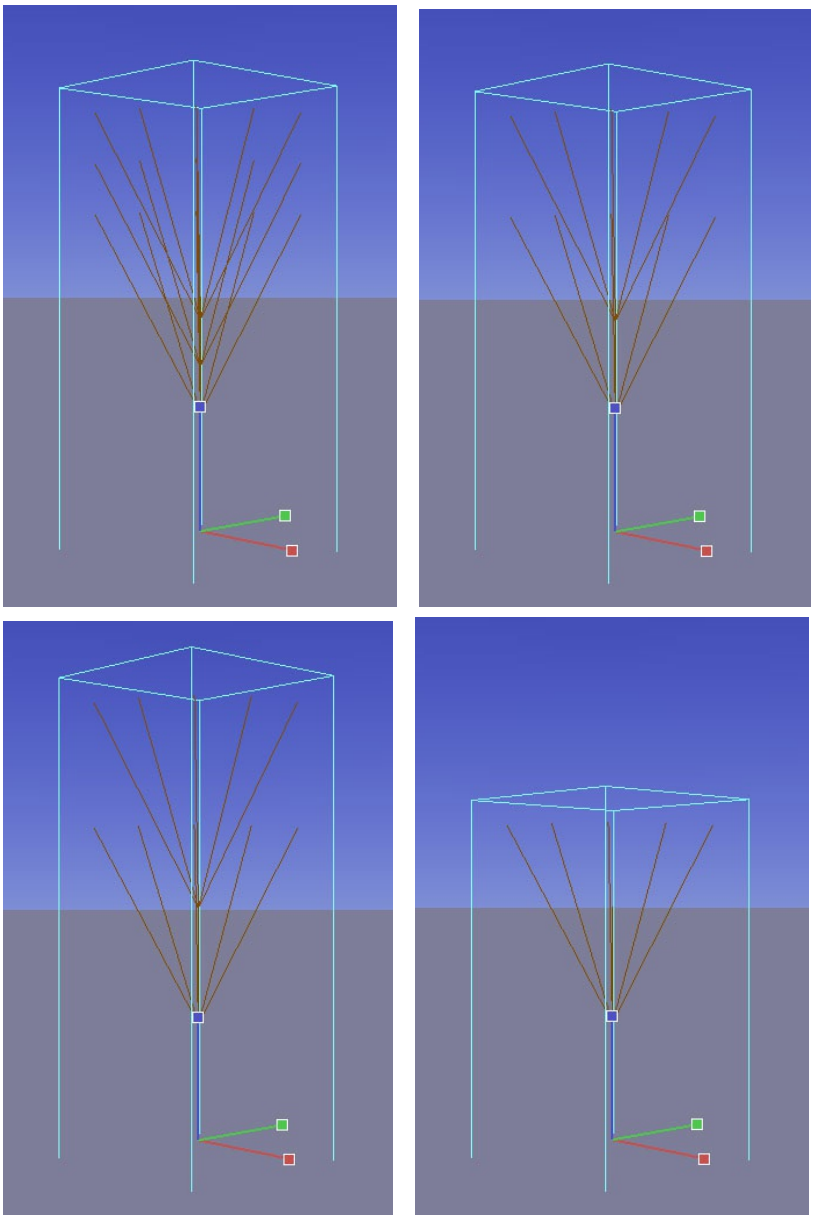
Group Size of 5 with the Group Radial Distribution set to 360, 180, 90, and 45

The default value for First Group Position is 1.0, which puts the child group at the very tip of the parent Branches object. Setting the First Group Position parameter to 0.5 does a moderately surprising thing:



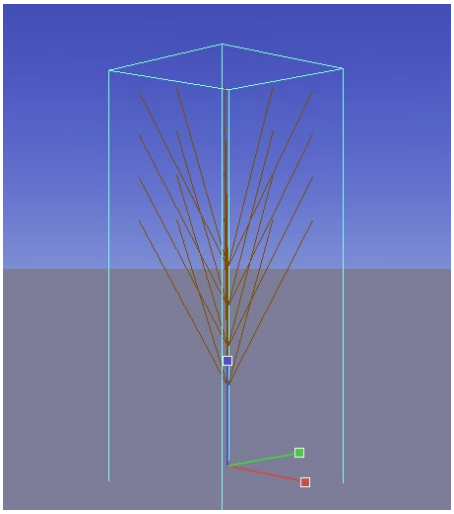
The first group of child objects appears at 0.5 and the other groups at 0.6, 0.7, 0.8, 0.9, and 1.0 all appear because the Group Axial Spacing parameter has a default value of 0.1 which causes additional groups to appear every 0.1 units along the branch above the First Group Position.

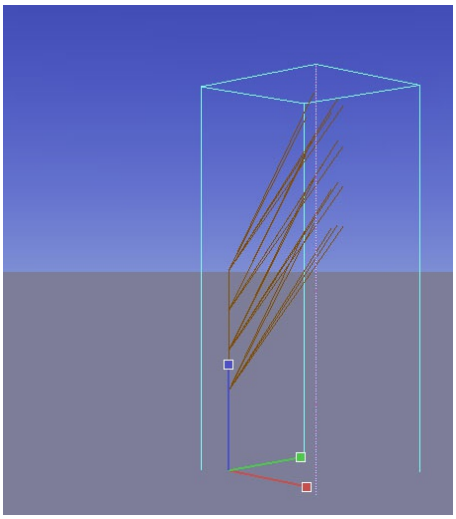
In the next set of images, the Group Axial Spacing has been set to 0.2, 0.3, 0.5, and 0.6. With the 0.2b setting, child groups appear at positions 0.5, 0.7, and 0.9. With the 0.3 setting, child groups appear at positions 0.5 and 0.8. With the 0.5 setting, child groups appear at positions 0.5 and 1.0. When the Group Axial Spacing is larger than (1.0 - First Group Position), a single group appears at the First Group Position.

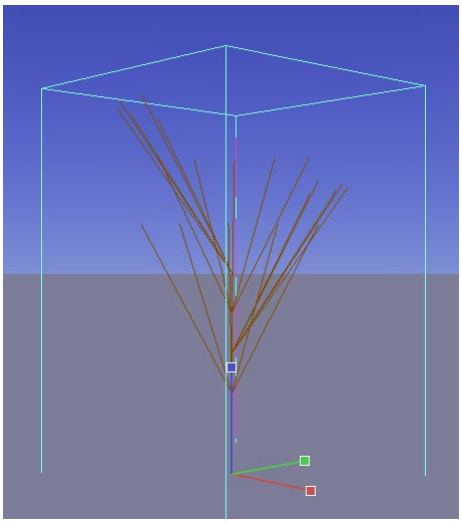


Group Axial Spacing at 0.2, 0.3, 0.5, and 0.6

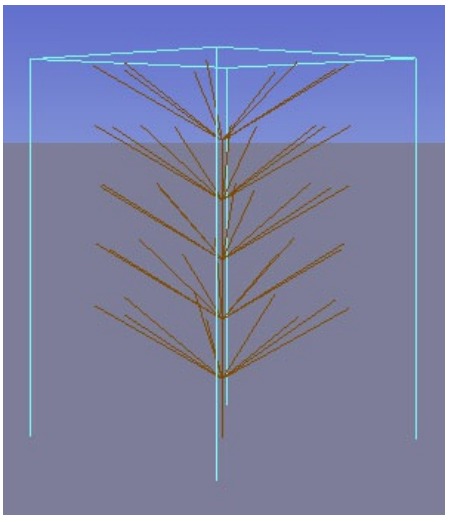
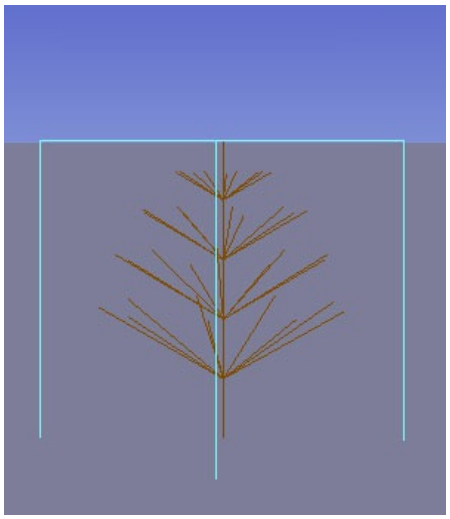
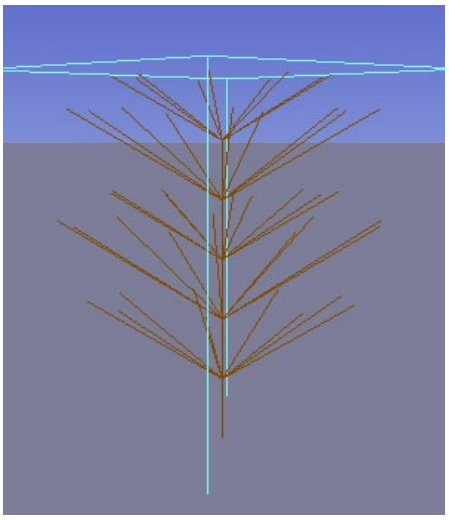
For the last several images, the Group Radial Distribution has been set to 90. This will help in showing the effects of Base Twist and Group Twist. The following images show child groups starting at a First Group Position of 0.4 with a Group Axial Spacing of 0.2. In the first image, both the Base Twist and Group Twist parameters are set to 0. In the second image, the Base Twist has been set to 90 but the Group Twist is still set to 0. In the third image, the Base Twist has been returned to 0 and the Group Twist has been set to 90:





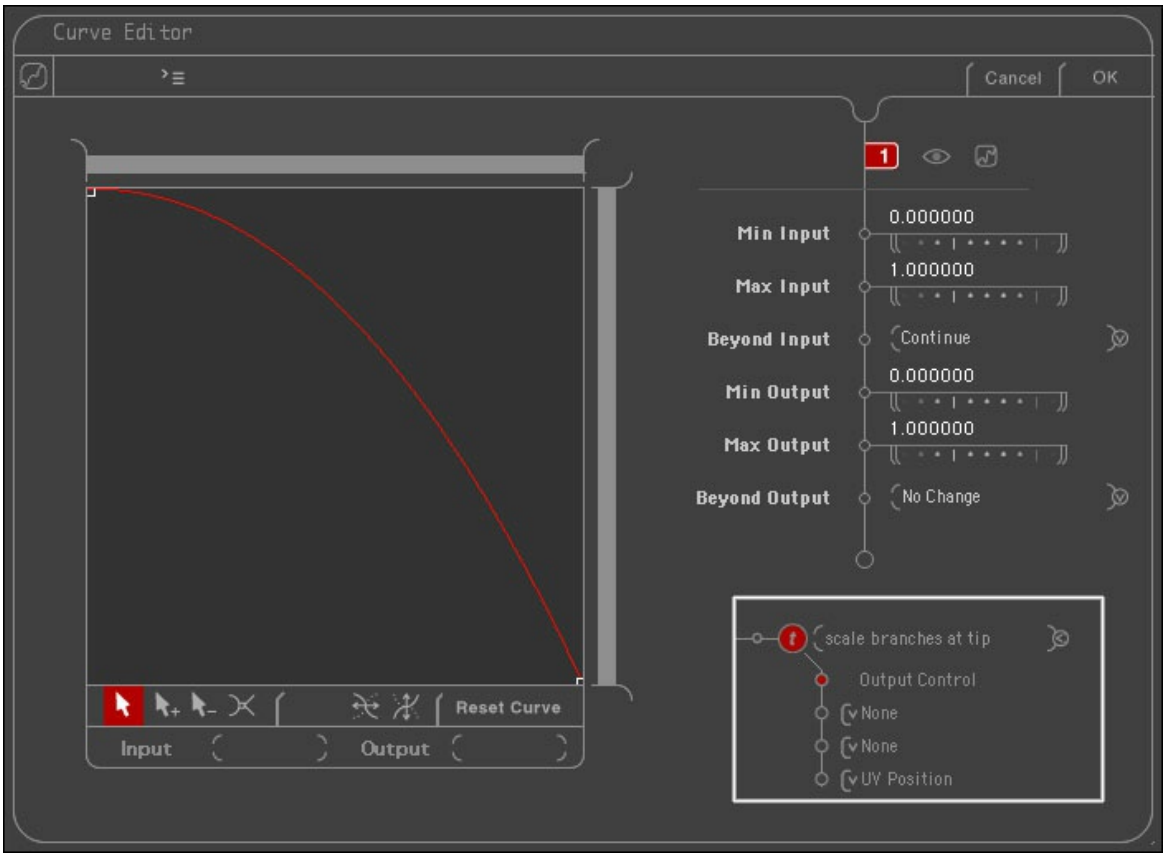


The final parameters inside of the Child Groups control stack are the Enable checkbox and the Branch Origin Offset. Turning off the Enable checkbox will hide the child objects and any objects which are children of those child objects. The Branch Origin Offset parameter will be covered in the next tutorial on Creating Variety. A parameter of the parent Branch that can affect the Child Groups is the Branches Scale parameter. These next images show a tree whose multiple Child Groups are scaled by a constant 1 and then where the Branches Scale parameter is based on the U coordinate of the parent branch and lastly, one where the Branches Scale parameter is a noise in World Position:

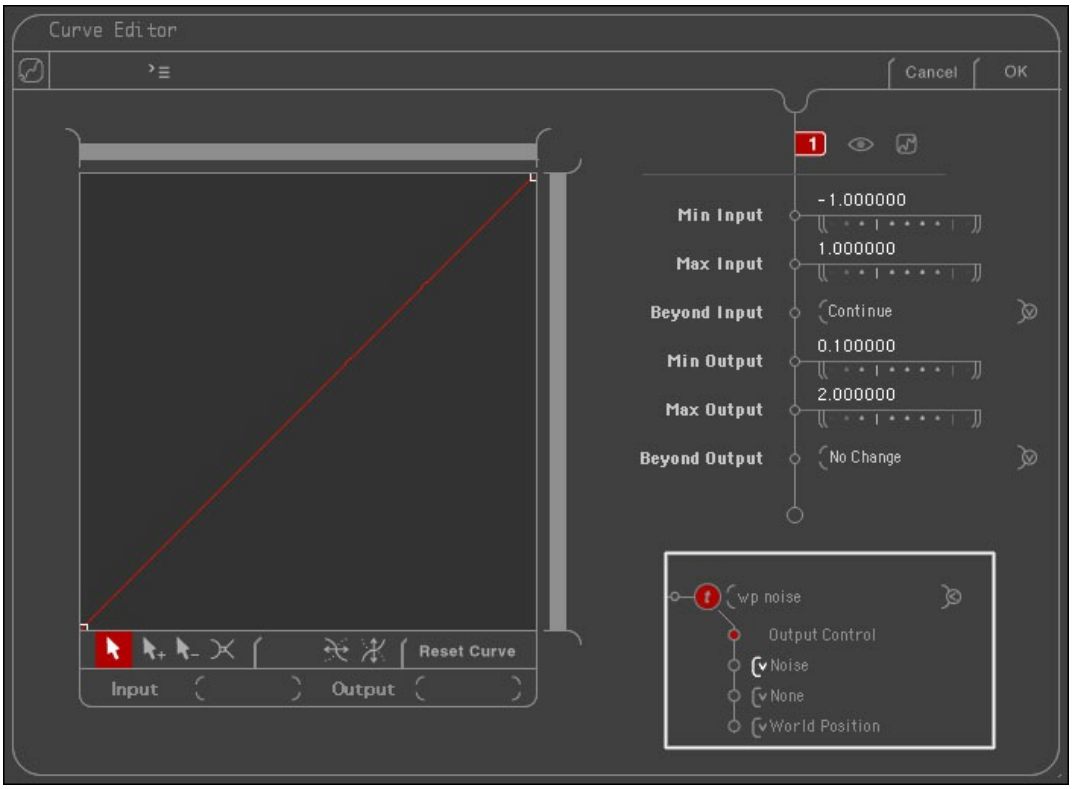




The textures driving those last two are simple single-leaved textures. The first is the straight UV Position input to assign values based on the position along the branch's axis. The second uses a Noise in World Position coordinates.

This last texture gives a glimpse into how we'll create variety in the trees across the forest.


Curve Editor
Cancel
OK
1
Min Input
0.000000
Max Input
1.000000
Beyond Input
Continue
Min Output
0.000000
Max Output
1.000000
Beyond Output
No Change
Reset Curve
Input
Output
scale branches at tip
Output Control
None
None
UV Position

Creating Variety



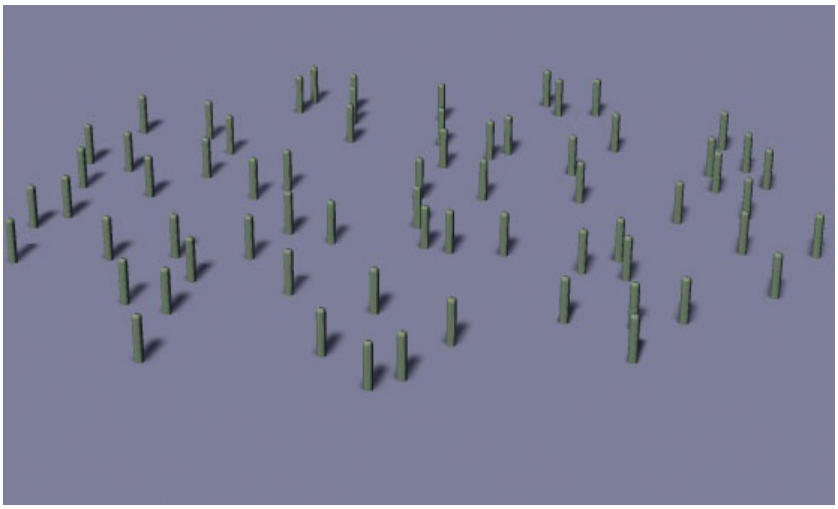
Many of the parameters of the MojoTree Branches object can be driven with textures or functions. Some parameters will evaluate their textures only at the origin point of the Branch or Leaf object. Other parameters will evaluate their textures along the length of the branch's axis, in much the same way as the textures we've used to taper the trunk Radius and the Branches Scale in previous tutorials.

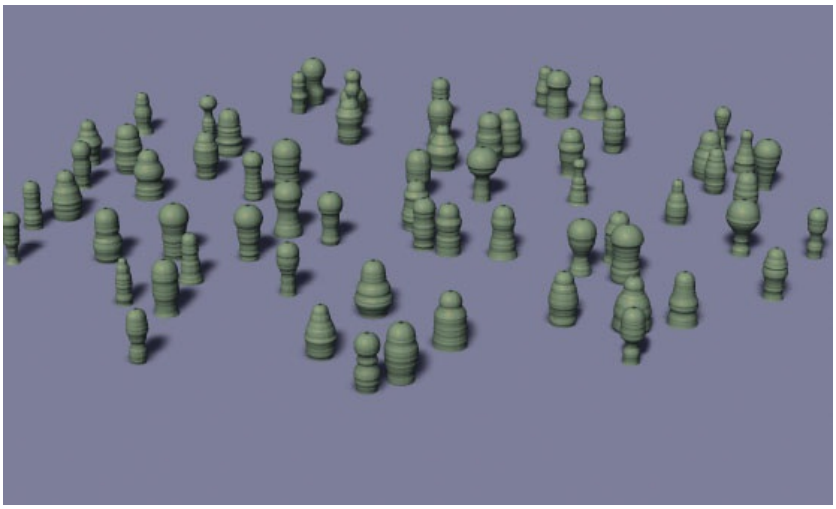
Parameters which evaluate only at the Branches object origin point (and thus are not suited to being driven with UV-based textures) are:Scale • Length • Base Twist • Num Segments • Offset • Child Base Twist • Child First Group Position • Child Branch Tilt • Child Branch Origin Offset

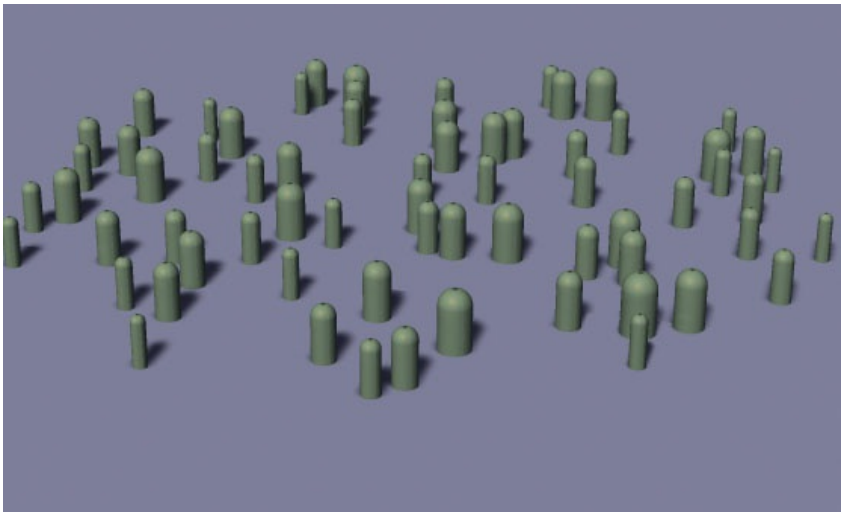
Parameters which evaluate along the Branches object axis (and thus are suited to being driven with UV-based textures) are:Radius •

Branches Scale • Segment Twist • Segment Tilt • Child Group Size • Child Group Twist • Child Group Radial Distribution

We'll start fresh in a new world with a new Local Forest with a default MojoTree Branches object as the Variety 0 tree. Remember to have your camera low to the ground to see the trees. The first parameter we'll look at is the Radius. In the Shaping MojoTree Branches tutorial, we shaped the radius with a texture in UV Position to taper it. We'll next consider two texture configurations where the difference is the input used. The first of these textures gets defined in World Position and the second in Surface Position. Since the effects of the Radius parameter only show in renders, the trees in the following images have had a simple 'New Material' applied to them. The three images show the effects of the Radius parameter first driven with the default constant of 1.0, next driven with a texture in World Position, and third with a clone of the World Position texture with the input changed to Surface Position:







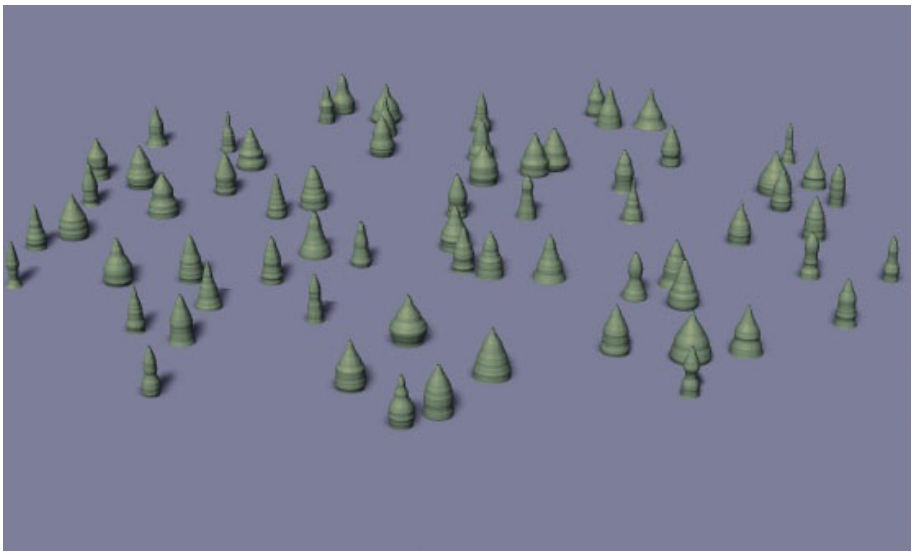
The next image shows a bit of a closer look at the “Radius - World Position” texture.

The Monofractal in this texture has a Largest Feature Size of 10. This was chosen based on the Clipping Distance of the forest. The Local Forest shown has a Clipping Distance of 100 meters, so in order to show significant variety within that local area, the Largest Feature Size of the textures creating the tree variations needs to be less than the size of the Clipping Distance.

The Surface Position variant was created by cloning the “Radius - World Position” texture and changing the input coordinates from World Position to Surface Position. When the axis of the Branches object is

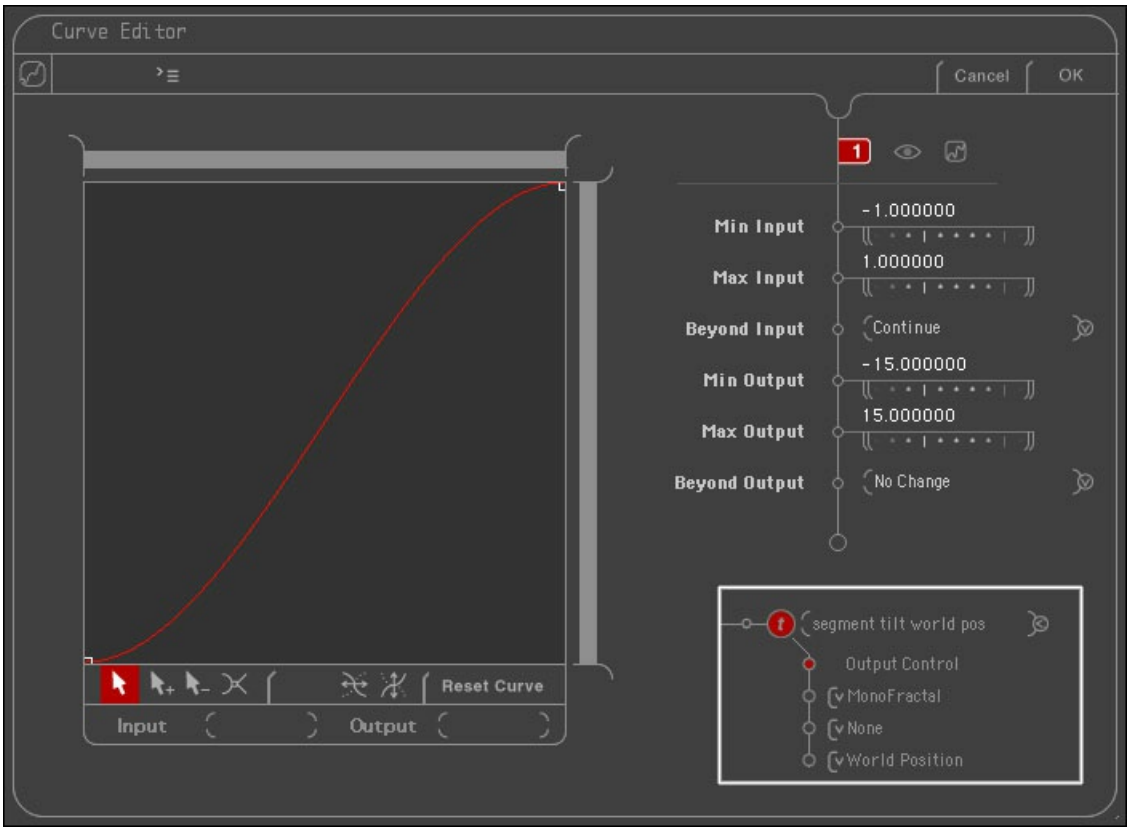
vertical, every point along it occupies the same Surface Position, so the radii of the trunks are different from tree to tree but constant along any given tree.

The last image multiplies the ‘radius-worldpos’ texture leaf by a ‘radius-taper’ texture leaf made much like the taper example in the Shaping MojoTree Branches tutorial.

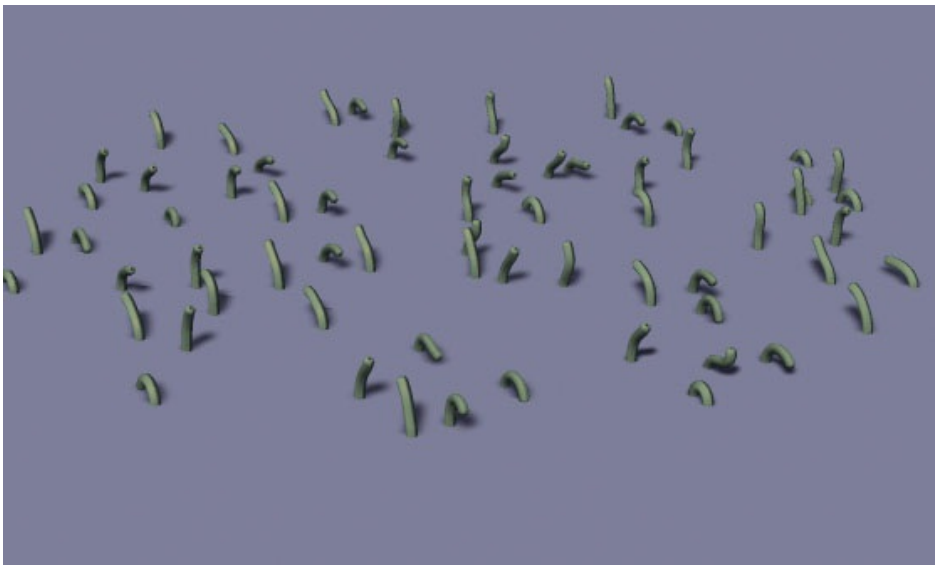


'radius-worldpos' texture multiplied by 'radius-taper' texture

Another parameter we looked at in an earlier tutorial with an ‘along the axis’ texture was the Segment Tilt parameter. Here we’ll revisit it with a texture in World Position. The Branches object used for Variety 0 in the forest in the next screenshots has a Num Segments value of 20. The Segment Tilt texture is defined as follows, with the Monofractal’s LFS set to 10 meters:



As with all of these textures, the majority of the work is done in the Curve Editor. The texture leaf is shown in the inset as a reminder. The Result Scale of the Monofractal is the default of 1.0, so the values coming into the curve span the range of -1.0 to 1.0 which the Curve Editor here remaps onto a range of -15 to 15 degrees. The resulting effect on the forest looks like this:

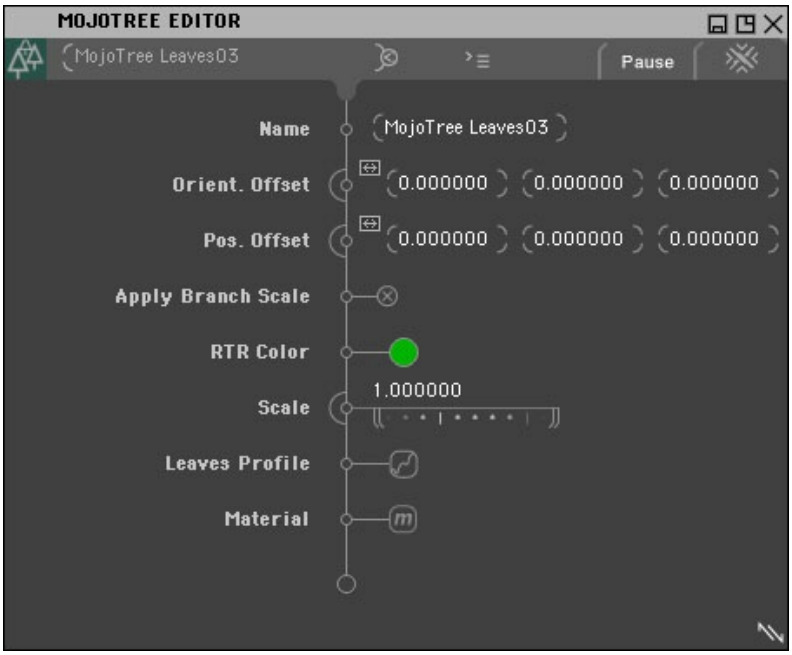


Each tree in the forest has its segments tilted at different angles depending on where the axis of the Branches object intersects the World Position texture.

Many other parameters of the Branches object and Leaves object can be driven with textures in a variety of input coordinates to create a wide variety of trees across any one given tree structure.

MojoTree Leaves Editor

The Leaves editor dialog allows you to shape and position MojoTree Leaves elements.



Name
Give your leaves unique names in order to identify them in the Variety and Child DDLBs.

Orient. Offset
The leaf orientation offset specifies the number of degrees to rotate about the X, Y, and Z axes. The default value of 0,0,0 does not rotate the leaf.

Pos. Offset
The leaf position offset specifies the number of meters to offset the leaf. For example, offset in the negative Z direction would move the leaf toward the ground.

Apply Branch Scale
This is on by default and causes the leaf to be scaled according to the Branches Scale parameter of the branch on which this leaf is a child element. The default configuration of each Branches object and each Leaves object set up to use the scaling defined by its respective parent object, an entire plant can be easily resized by simply re-scaling the base parent element.

RTR Color
Use this to color-code the leaves in the RTR preview.

Scale
Applies an overall scaling to the leaf. This can be useful to scale leaves which use material displacement effects for additional shaping.

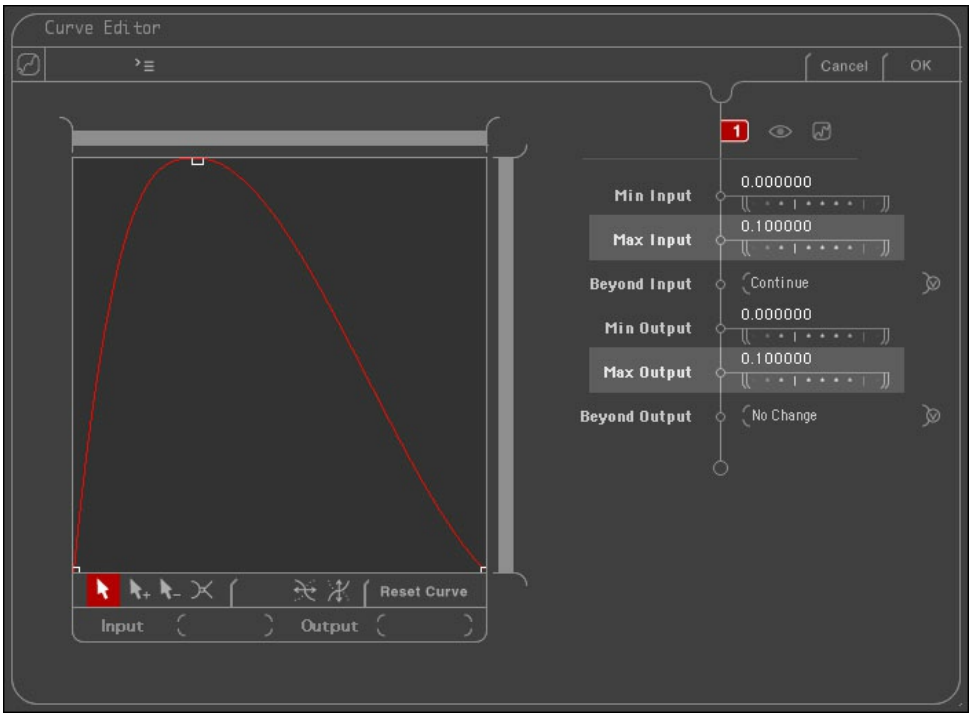
Leaves Profile
This curve editor defines the primary shape of the leaf. See the diagram below for a graphical explanation.

Material
Opens a material editor to define the material for the leaf. Complex leaf shaping can be achieved by using the Displacement parameter on the leaf material.

See the MojoTree Leaf Shaping Tutorial

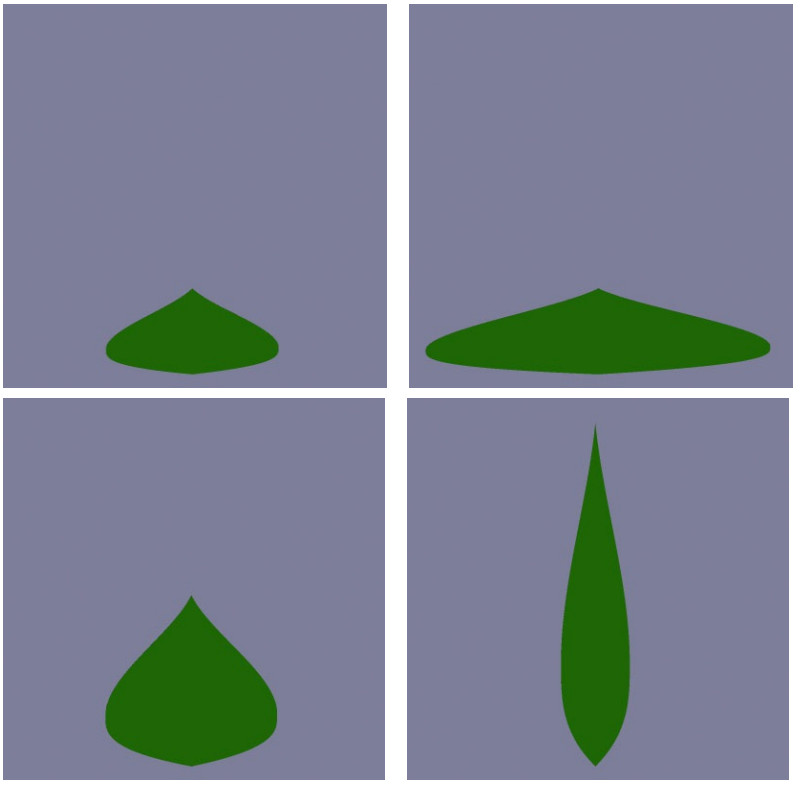
MojoTree Leaf Shaping Tutorial

The most important part of shaping leaves is the Leaves Profile Curve. The Curve Editor's concept of Min/Max Input and Min/Max Output are interpreted a bit differently in this usage than in Generator textures. Imagine the area of the curve editor as representing a piece of paper folded in half. The bottom edge of the graph area is the fold. The curve line represents where you'd cut with your scissors to cut out a leaf shape from the paper. The Min/Max Input range specifies the length of the paper along the fold. The Min/Max Output range specifies the width of the paper from the fold to the edges. For the Leaves Profile Curve, the Min Input and the Min Output both must be set to zero. The Max Input and Max Output determine the size of the leaf in meters before any scaling is applied.



The previous image is the default leaf profile curve. Note its Max Input and Max Output values are both set to 0.1. This creates leaves which are one tenth of a meter long and two tenths of a meter wide.

A great deal of shape variety can be had using the same curve, but changing the Max Input value, which will affect how long the leaf is from base to tip, or by changing the Max Output value, which will affect how wide the leaf is from side to side. The default value for the Max Input (length of the leaf) is 0.1 meters and the default value for the Max Output (half the width of the leaf) is 0.1 meters. The following five different leaf shapes were made using the default leaf profile but by changing the Max Input and/or Max Output values in the Leaves Profile Curve Editor. The first has the Max Input set to 1 and the Max Output also set to 1, which creates a leaf 10 times the size of the default leaf. The next one doubles the Max Output. The third uses 2 for the Max Input and 1 for the Max Output. The fourth example has a Max Input of 4 and a Max Output of 0.4 to create a very long and narrow leaf.



The curve used for that last leaf is exactly the same shape as the default leaf profile curve, but the Max Input and Max Output values have been changed significantly from the default value of 0.1:

Note that changing the leaf profile curve itself does not change the RTR representation of the leaf. The RTR always shows the leaf as an elongated diamond shape. In the Curves library installed with the MojoTree Library, the preset curve ‘MojoTreeLeaves02’ will make a leaf whose fully rendered shape matches the shape of the leaf preview in the RTR.

MojoMove

MojoMove allows you to quickly create animations with MojoWorld. The MojoMove add-in package consists of the animationnodes.dll plug-in file and several libraries of presets. MojoMove is installed as part of MojoWorld Pro. For instructions on how to install it as an add-in to MojoWorld Standard, please see the documentation included with the MojoMove serial number.

This section will cover:
• The layout and functionality of the MojoMove Editor
• How to load and adjust animated content
• The control sets associated with the different types of animated content
• How to preview animations in the MojoMove Editor

MojoMove Editor

The MojoMove Editor is found below the Object List icon in the Global Parameters tools. The MojoMove Editor Title Bar has the standard Stow, Maximize, and Close buttons. The next row displays the MojoMove Editor Icon on the left, and the Pause and Jump buttons on the right. The MojoMove Editor Icon identifies the MojoMove Editor when stowed in the Editor Stow area.

The MojoMove Editor consists of a Preview area and a Control Stack. Items on the Control Stack depend on what animated presets have been applied to your MojoWorld.

Preview
The left portion of the MojoMove Editor contains the Preview area. This is where you can render small test versions of your animated features. The options available underneath the Preview image depend on the setting of the first Preview Mode option.

Preview Mode
The Preview Mode DDLB lists two options, ‘Render Animation’ or ‘Render Current View.’ ‘Render Animation’ is the default. Choosing the ‘Render Current View’ option causes several of the additional controls below to disappear, as they do not apply to a still frame render.

Setting
The Setting DDLB is where you choose a render setting to use for the Preview render. The pixel dimensions of those render settings are ignored, but the Antialiasing, Geometry Detail, Reflections checkbox and Shadows parameters of the chosen render setting are all used. The listing of render settings is divided into two sections. The first section lists the built-in render settings. The second section lists any custom render settings

you may have defined in the Render Settings Editor.

Start Time
This option is only visible when the Preview Mode is set to ‘Render Animation.’ The Start Time defaults to zero. Note that if you have recorded an interactive flight path and have used the calipers in the Movie Editor to trim off the beginning of the recording, you may want to set the Start Time equal to the Global Time at the beginning
of the clip. The easiest way to determine this value is to go into the Movie Editor and click the ‘Go to First Frame’ button. When you return to the MojoMove Editor, the Global Time dial will indicate at what Global Time the animation will begin.

Duration
This option is only visible when the Preview Mode is set to ‘Render Animation.’ The Duration defaults to 1 second. Duration cannot be set to less than 0.1 seconds.

Frame Rate
This DDLB is only visible when the Preview Mode is set to ‘Render Animation.’ The default Frame Rate is 10 frames per second. Keep in mind that the MojoMove Editor’s Preview is designed to give quick previews of your animations!

Fit to Box
This checkbox is present for both Preview Mode options. When checked, the Preview render will ignore any aspect ratio of the chosen render setting and will instead fit the preview render to the square area. When this option is not checked, the Preview render will use the same aspect ratio of the chosen render setting.

Play / Pause button
This button is only present in the ‘Render Animation’ Preview Mode. It is grayed out when the editor is opened and while Preview rendering is in progress. After at least one frame of an

animated preview has been rendered and rendering is no longer in progress, the Play button will be active. The button will now toggle between the Pause and Play buttons, stopping and starting the playback of the completed frames.

Render Now Camera / Stop button
This button is present in both Preview Modes. In its default state, it appears as the still camera ‘render now’ icon. When clicked, a preview render begins and the button changes to the Stop icon. The button will revert back to the still camera icon either when the preview render completes, or the preview render is stopped by clicking the Stop button.

Movie Camera lock button
This button is present only in the ‘Render Animation’ Preview Mode. It toggles the behavior of the camera with respect to any interactive flight path it may have recorded onto it. The default state is for the Movie Camera to allow camera motion in the Preview render. Clicking the Movie Camera lock button puts an X over the Movie Camera icon and keeps the current camera in place regardless of any interactive flight path it may have recorded onto it. NOTE: The Movie Camera lock icon only applies to an interactive flight path that has been recorded onto the current camera. It will not prevent a camera under the control of a KH_Avion or KH_Mover plugin from moving!

MojoMove Control Stack
The right-hand portion of the MojoMove Editor contains the MojoMove Control Stack. Options on this control stack depend on what MojoMove animated presets have been loaded. The top two controls are always present.

Global Time
The Global Time dial can be used to ‘wind time forward’ in the RTR so that you can render a test still frame of your action at any arbitrary time. When time is recorded to queue for a movie render, the Global Time will always start at 0. Moving the left-

hand caliper on the timeline in the Movie Editor will move the actual start time of your movie render to a Global Time larger than 0.

Time Dial Options

This DDLB controls how the animated elements affect the RTR Window. Each option has two portions separated by an ampersand. The first portion is either “Live Only” or “All” and this refers to the type of animated elements that will be affected by the Global Time dial setting. When “Live Only” is specified, only animated elements defined as “Live” will respond to changes in the Global Time dial. See the description of the types of animated elements below for a definition of a “Live” element. When “All” is specified, all animated elements will respond to changes in the Global Time dial. The second portion of each option is either “Fixed Cam” or “Moving Cam” and this refers to any interactive flight path which may be recorded in the movie editor on the current camera. When “Fixed Cam” is specified, the current will be unaffected by changes to the Global Time dial,regardless of any interactive flight path that may be associated with that camera. When “Moving Cam” is specified, moving the Global Time dial will affect the current camera’s position as defined by any interactive flight path that may be associated with that camera. NOTE: The Fixed Cam options only apply to an interactive flight path that has been recorded onto the current camera! They will not prevent a camera under the control of a KH_Avion or KH_Mover plugin from moving!

Items on the control stack below the separator line will be on Control Stack Expanders according to the editor in which the animated elements are found. For example, an animated cloud layer will be on the Atmosphere Control Stack Expander, an animated sun light will be on the Sun Control Stack Expander, and an animated material applied to a primitive or a model will be on the Other Control Stack Expander.

Types of Animated Elements

Creating new MojoMove content requires use of MojoGraph. The different types of controls which appear on the MojoMove control stack expansions for the various elements depend on the MojoMove node or nodes used to define the element.

Any of these types of elements may or may not be “Live.” There is no way to tell from looking at the MojoMove Editor whether or not an element is “Live,” however, some common sense rules apply. The meaning of “Live” is that the RTR updates with passage of time, either while recording time to be queued for the final movie, or while interactively twiddling the Global Time dial in the MojoMove Editor. Some elements are not “Live” because they animate an element that is not ever shown in the RTR, such as ocean waves created by an animated displacement texture. Other elements are not “Live” because they animate an element that would slow the RTR down too much, such as an animated land texture. Elements that are commonly “Live” are orbiting Moons and Sun, or moving clouds. For the moving clouds, unless the RTR Preview mode has been set to ‘Textured with Clouds’ the fact that they are “Live” may not be evident.

MM SpaceTime
This type of animated element controls a 4-dimensional texture. It causes a single thumbwheel to appear in the associated control stack expansion. Usually, animated elements of this type have a name that refers to a ‘Speed’ or ‘Rate’ and often the default values for these dials are fairly large. Decreasing the value will slow the associated effect. Increasing the value will speed up the associated effect. The effects of 4-dimensional fractals are often used for mid-ocean waves, roiling clouds, or an uneasy terrain.

MM Instance
An animation ‘instance’ will have its own Control Stack Expander with three parameters. The first is the Mode, the second is a Start Time,

and the third is a Duration. The Start Time and Duration parameters are both specified as a number of seconds. The Mode may be one of the following:

One Shot
The animated element does not start until the Start Time, lasts for the Duration, and then does not occur again during the remainder of the Preview's duration or the final Movie's recorded time.

Pendulum
The animated element carries on forward and then backward and then forward again throughout the Preview's duration or the final Movie's recorded time. If the Start Time is a value other than 0, the action in interpolated back to 0 and begins at the appropriate offset. The Duration specifies how long a single forward instance lasts.

Repeat
The animated element repeats throughout the Preview's duration or the final Movie's recorded time. If the Start Time is a value other than 0, the action is interpolated back to 0 and begins at the appropriate offset. The Duration specifies how long a single repetition lasts.

MM Time
This type of animated element appears as a Control Stack Expander with two parameters on the expanded stack. The two parameters are Time Offset and Scale. A common use for this type of element is to drive the orbit of the Sun or a Moon.

MM WorldPos Rotate
This control is always used in conjunction with either the MM Instance node or the MM Time node. The MM WorldPos Rotate will add a rotation dial control to the stack labeled Move Direction. A common use for this type of control
is to create the effect of clouds which drift in a specific direction,

instead of simply roiling in place. The MM WorldPos Rotate is also often used in conjunction with the MM SpaceTime node.

Orbit Driving

When the MojoMove add-in is present, the Orbit Position parameter in the Sun Editor and in the Moon Editor for Moon objects has the ability to automatically create an Orbit Drive function. Click the semi-circle next to the Orbit Position parameter. It will have two options on it, Widget and Time Graph.

Selecting Time Graph will cause an Orbit Drive function to be built. This will add an MM Time element to the MojoMove Editor for that Sun or Moon. The Time Offset can be used to put the Sun or Moon at a different place on its orbit. The Scale parameter controls how fast the Sun or Moon will move. Set it to 0 to prevent the Sun or Moon from moving during an animation. Set the Scale to a negative value to reverse the direction of the orbit. The default Scale of 1.0 will move the Sun or Moon at one degree per second, which is quite fast for a natural celestial body, but quite appropriate to create a ‘time lapse’ style of movie.

Queueing and Rendering the Final Movie

After setting up and tweaking a host of animated presets, it's time to create the final movie. Your movie may be one of three forms. The camera may sit in place and the only action is what has been defined by animating elements of the MojoWorld. Alternately, you may record an interactive flight path using the Fly or UFO tools. Lastly, you may be moving the camera and/or other objects in your MojoWorld using the third-party animation tool plug-ins (KH_Mover, KH_Avion, KH_Nurbs, and / or KH_Path).

In all of these cases, before a Movie can be put into the Uplink Queue to be rendered, some time must be recorded in the RTR. The second form of Movie described above, the recording of an interactive flight path using the Fly or UFO tools, already involves recording time into the RTR. The other two forms of Movie still require that time be recorded even if no interactive flight path will be used!Once time has been recorded, use the Movie Editor to put the job into the Uplink Queue. This process is covered in detail in the Movie Editor sections of both the Viewer and Generator chapters in this manual.

Material Type Properties Reference

Material Type Properties Reference

These material types are found in any Material Editor on the DDLB underneath each Material Leaf. The types covered in this reference are the four which ship with MojoWorld. Additional material types may appear on this DDLB when added as plug-ins, either from Pandromeda or from third party plug-ins.

Displacement Material

This is the default material type. It is a very powerful and flexible material and is the most commonly used material type.

Name

The name you give your Displacement Material appears beside the currently selected Material Leaf, and in the Name DDLBs of other Material Leaves.

Diffuse

Controls the matte color of the material. The Widget controller is a color dot. Changing the parameter to a texture opens a Color Texture Editor.

Specular

Controls the color of the shiny highlights. The Widget controller is a color dot. Changing the parameter to a texture opens a Color Texture Editor.

Shininess

Controls the glossiness of the surface. Low values give large broad highlights, high values give small, sharp highlights. The Widget controller is a thumb wheel. Changing the parameter to a texture opens a Value Texture Editor.

Displacement

Specifies the distance that the surface should be moved (displaced) along the surface normal. The Widget controller is a thumb wheel. Changing the parameter to a texture opens a Value Texture Editor. Displacement is what allows MojoWorld planets to have overhangs. When used in materials applied to the planet, negative values push the surface outward and positive values push the surface inward. Displacement will actually change the shape of MojoWorld primitive objects, so use care with the scaling, as values which are too extreme can cause the primitive to be ripped apart and either not render at all or cause bad render artifacts. When applied to imported mesh models, Displacement does not actually change the shape of the mesh, but rather it creates a bump map. Until computers get a heck of a lot faster, Displacement will not show in the RTR, nor will it show in rendered reflections.

Glow
Glow gives the surface material its own light. Glow does not cause the material to become a light source that illuminates other objects. The widget is a color dot. Changing this parameter to a texture opens a Color Texture Editor.

Transparency
Determines the transparency of the material. The widget is a color dot. Black is opaque; white is transparent. Changing this parameter to a texture opens a Color Texture Editor. See also the Refraction parameter in the Ray Tracing Control Stack for more information regarding transparent materials.

Ray Tracing Control Stack
This Control Stack expands to show the additional Ray Tracing parameters which provide reflection and refraction effects. These are similar to the Ray Tracing parameters of a Water Material, but not identical.

Reflection
This Color dot allows you to set how much light is reflected

from the surface of the material. Setting this to black stops any reflection; white will create a perfectly reflective mirror. Changing this parameter to a texture opens a Color Texture Editor. Note that Reflections are not only dependent on the setting of this parameter, but also on the setting of the Enable Reflections parameter in the render setting.

Refraction
This Color dot sets how much light is transmitted through the surface. Black means no light is allowed through; white creates a completely transparent surface. This differs from the normal transparency control, as the light gets bent when it hits the surface. Refraction is much slower to calculate than the standard transparency effect. Note that refraction effects are also dependent on the setting of the Enable Reflections parameter in the render setting.

Refractive Index
Controls how much the light is bent when it is transmitted through the surface. In practical terms, the greater the index of refraction, the more the material reflects light. A value of 1.0 acts like air. The default value is 1.5, which is similar to glass. The effects of this parameter will not be visible unless the render setting used has Enable Reflections active.

Max Bounces
Determines how many times a ray can be reflected or refracted before it is arbitrarily stopped. Many situations (particularly with refractive objects) can get rays that will bounce around inside things a very large number of times, but contribute almost nothing to the final image. This slows renders, so this control lets you set an upper limit on the number of bounces. The default value of 5 should be sufficient for most cases, but if you want to create a “hall of mirrors” effect you may need to raise this value. If large sections of refractive materials render as solid black, try

setting the Max Bounces larger. This parameter cannot be driven with a Texture.

Search Distance
Intersecting rays with the planet surface involves searching along the ray for places where it hits. Renders will slow down the further the ray has to search. The Search Distance specifies how far to look for intersections with the planet surface. If this value is set too low, you will see the reflections of the terrain start to vanish, generally as the tops of mountains begin to be chopped off. Setting this too high will increase render times, so experiment with this if ray trace renders are taking a very long time. This control only applies to planet intersections. Intersections with all other objects will be found regardless of how far away they are. This parameter cannot be driven with a Texture.

Error (speed vs. quality)
This controls how accurately the ray tracer finds intersections with the terrain. Low values are very accurate, but take a long time to render, higher values get progressively faster and less accurate. For many situations (i.e. reflections of the terrain in a displacement-mapped ocean) the accuracy of the intersections has very little impact on the final image, so you can raise this value and get much faster renders. Conversely, if you want absolutely perfect mirror-like reflections of the terrain, you will probably need to lower this from the default value. If this value is set too high the reflections will appear grainy particularly around the edges of the terrain. As with the Search Distance, this control only applies to planet intersections. All other objects get accurate intersections regardless of this value. This parameter cannot be driven with a Texture.

Nested Material Tree

A Material Leaf of this type has a single parameter in the control stack and that parameter is identical to the Material Editor DDLB also found in the upper left corner of the Material Editor. This allows an entire Material Tree to be used as a leaf within another Material Tree. In effect, this means that you can create Material Trees with an unlimited number of leaves. However, the material slows down as you add more nested trees.

A special type of Material Tree is created when a multi-part 3d model is loaded. It will have a Material sub plug-in editor for each piece of the model. Because this is a special derivation of the Nested Material Tree, the DDLB underneath the Material Leaf for this variant will be empty.

Name
The name you give your Nested Material Tree appears beside the currently selected Material Leaf, and in the Name DDLBs of other Material Leaves.

Material Tree
A DDLB listing all currently defined Material Trees.

UV Image Material

This is the base material type for PhotoBillboard objects. However, because the PhotoBillboard creates a special variant of the UV Image Material, the DDLB underneath the Material Leaf for this variant will be empty.

Name
The name you give your UV Image Material appears beside the currently selected Material Leaf, and in the Name DDLBs of other Material Leaves. When the UV Image Material is created automatically as part of creating a photo billboard, the name of the Material Tree and the Material Leaf both use the image file name as part of this name string. For example, creating a photo billboard with the image file “NeonMo.tif” will create a Material Tree named, “NeonMo Material [Tree]” with a single Material Leaf of type UV Image Material named, “NeonMo Material.”

File Name
Displays the full pathname of the image file. The field is followed by a ‘Load From Disk’ icon. It is strongly recommended when loading an alternate image to always use the load icon rather than typing in a file pathname.

Flip Image
This DDLB lists four options; No Flip, Flip Horizontal, Flip Vertical, and Flip Both.

Alpha
This DDLB lists three options; Normal, Invert, and Ignore. This determines how the material uses the transparency information in the image’s alpha channel.

Contrast
A value between -1 and 1, where the default of 0 does not affect

the contrast in the original image. This parameter cannot be driven with a Texture.

Brightness
A value between -1 and 1, where the default of 0 does not affect the brightness of the original image. This parameter cannot be driven with a Texture.

Lighting
This Control Stack expands to show some additional parameters which affect how the UV Image Material responds to light sources in final renderings.

Allow Lighting
The default for this checkbox is off. When it is used in its standard context of a PhotoBillboard, this prevents the surrounding lighting from accentuating the fact that this is a simple 2D planar object.

Shininess
This thumb wheel widget defaults to 80. Low values give large broad highlights, large values give small, sharp highlights. Changing the parameter to a texture opens a Value Texture Editor.

Specular Level
The specular level defaults to 0.01 and cannot be made smaller than 0. This value determines the amount of contribution the specular source makes to the highlights.

Want Own Specular
This checkbox is off by default. When off, the material will use the image source itself as the specular color. When checked, the material will use whatever color or texture is attached to the Own Specular parameter instead. This checkbox is hidden when in Simple mode.

Own Specular
This color dot is black by default, and unless the Want Own Specular checkbox has been checked, the color or texture on this parameter will have no effect. Changing this parameter to a texture will open a Color Texture Editor. This parameter is hidden in Simple mode.

GL Preview
This Control Stack expands to show some additional parameters which affect how PhotoBillboard objects appear in the RTR. When creating a UV Image Material in a context other than on a PhotoBillboard object, the entire GL Preview Control Stack will not be present!

Preview Quality
This DDLB lists possible resolutions in powers of two. Larger values will slow RTR performance, smaller values will speed RTR performance at the cost of losing clarity on any PhotoBillboard objects.

AntiAlias
This checkbox is on by default and causes the image on the PhotoBillboard to be antialiased.

Enable GL Preview
When this checkbox is ticked, the image file is displayed on the PhotoBillboard in the RTR. This only applies to PhotoBillboard objects.

Water Material

The Water Material works best when it is applied to the Ocean primitive. In fact, the Water Material makes certain assumptions about how it should look based on where it finds the surface of the planet relative to the surface of the object using the Water Material. This means that a Water Material applied to your planet surface may not work as expected unless the object is placed quite close to the planet's surface. Similarly, a Water Material applied to a primitive or imported object will have unexpected effects.

Name
The name you give your Water Material appears beside the currently selected Material Leaf, and in the Name DDLBs of other Material Leaves.

Opacity (color)
These values determine the amount of light that gets absorbed by the water. The three values correspond to Red, Green and Blue values, but behave very differently than a color dot. Values larger than 1 are allowed. The higher the value, the faster the water absorbs that color of light. The effect of using this style of input instead of a color dot widget is that it results in a subtle range of colors over different depths. Setting any one of these values to 0 can cause unwanted black artifacts. Since the output of this parameter is best shown in a series of color renders, check the mojoworld.org website for a graphical explanation.

Transparency
Determines the transparency of the water. Larger values make the water more transparent.

Murkiness
This value determines the amount of detritus in the water. A Murkiness value of zero means the water is completely clear,

and as the value gets larger the water tends toward the Murk Opacity color as well as becoming less transparent overall.

Bright Highlight
This value determines the brightness of the highlights defined by the Shininess parameter.

Shininess
Controls the glossiness of the surface. Low values give large broad highlights, high values give small, sharp highlights.

Refractive Index
Controls how much the light is bent when it is transmitted through the surface. In practical terms, the greater the index of refraction, the more the water reflects light. The value clamps at 1.0 and the useful range goes up to about 5. For comparison, air has a refractive index of 1.0, water has a refractive index of 1.33, most glass has a refractive index close to 1.5, and diamond has a refractive index of 2.42.

Light Scattering
The degree to which light is scattered by water is determined by depth. You may modify this with the Light Scattering parameter. Larger Light Scattering values create brighter water; smaller values produce dark water. This parameter is hidden in Simple mode.

Murk Opacity
These parameters behave exactly like the Opacity as described above, but relate to the detritus in the water rather than the water itself. This parameter is hidden in Simple mode.

Displacement
Can be driven with a Texture or a Function Graph in order to displace the surface points to give 3D relief to the surface. The displacement texture displaces the surface in the direction of the surface normal.

Ray Tracing

This Control Stack expands to show the additional Ray Tracing parameters which provide reflection and refraction effects. These are similar to the Ray Tracing parameters of a Displacement Material, but not identical.

True Reflection
This checkbox allows you to turn on Ray Tracing for reflections. If it is unchecked, the Water simply reflects the clouds and the atmosphere. If the option is checked, then terrain and objects are also reflected. The amount of reflection is automatically calculated. Ray-traced reflections will only be visible in renders where the Enable Reflections parameter is checked.

True Refraction
This checkbox allows you to turn on Ray Tracing for refractions. Checking this option allows objects which are submerged in the Water to render. The terrain below the ocean renders regardless of whether this option is checked, however it renders differently. When this option is unchecked, the refraction effects are based on assumptions of the distance between the water material's surface and the planet's surface. When checked, the rays between the water's surface and the underlying terrain are traced out to create true refraction. Ray-traced refractions will only be visible in renders where the Enable reflections parameter is checked.

Max Bounces
Determines how many times a ray can be reflected or refracted before it is arbitrarily stopped. Many situations (particularly with refractive objects) can get rays that will bounce around inside things a very large number of times, but contribute almost nothing to the final image. This slows renders, so this control lets you set an upper limit on the number of bounces. The default

value of 5 should be sufficient for most cases, but if you want to create a “hall of mirrors” effect you may need to raise this value. If large sections of refractive materials render as solid black, try setting the Max Bounces larger. This parameter cannot be driven with a Texture.

Search Distance
Intersecting rays with the planet surface involves searching along the ray for places where it hits. Renders will slow down the further the ray has to search. The Search Distance specifies how far to look for intersections with the planet surface. If this value is set too low, you will see the reflections of the terrain start to vanish, generally as the tops of mountains begin to be chopped off. Setting this too high will increase render times, so experiment with this if ray trace renders are taking a very long time. This control only applies to planet intersections. Intersections with all other objects will be found regardless of how far away they are. This parameter cannot be driven with a Texture.

Error (speed vs. quality)
This controls how accurately the ray tracer finds intersections with the terrain. Low values are very accurate, but take a long time to render, higher values get progressively faster and less accurate. For many situations (i.e. reflections of the terrain in a displacement-mapped ocean) the accuracy of the intersections has very little impact on the final image, so you can raise this value and get much faster renders. Conversely, if you want absolutely perfect mirror-like reflections of the terrain, you will probably need to lower this from the default value. If this value is set too high the reflections will appear grainy particularly around the edges of the terrain. As with the Search Distance, this control only applies to planet intersections. All other objects get accurate intersections regardless of this value. This parameter cannot be driven with a Texture.

Atmosphere Type Properties Reference

These atmosphere types are found in the Sky Editor on the Atmosphere DDLB. In addition to the three types of Atmosphere listed below, the Atmosphere DDLB in the Sky Editor can also be set to 'None' which eliminates all atmospheric effects. Additional atmosphere types may appear on this DDLB when added as plug-ins, either from Pandromeda or from third party plug-ins.

A Word of Caution

Although many parameters of the included atmosphere types can have textures attached to them, the formulas behind calculating the atmospheric effects assume that parameters such as density and the like are either constant or change in known ways (such as the atmosphere getting less dense with altitude). Textures or functions attached to these parameters will only get called in one place (probably the point on the planet at that pixel, or maybe the background if it's in the sky), and those values will be assumed constant for that pixel's atmosphere calculation. There are plenty of occasions where it looks cool (the word "works" doesn't really apply), so we left the textures enabled. Be warned, however, that using textures to drive many of these atmospheric parameters, while it may look cool from one camera view, may look just dreadful from another camera view!

Cloudy Atmosphere

The Cloudy Atmosphere is the default atmosphere you will get with a new planet. You can edit the following parameters of the Cloudy Atmosphere:

Name
The name can be edited. When saving a sky preset to the library, the default name it uses is the one from this name field.

Height
The height of the atmosphere describes how far it expands from the MojoWorld. The greater the value, the further the atmosphere extends into space. The valid range is 0 to 1, where a height of 0 results in no atmosphere and a height of 1 extends the atmosphere one planet radius out from the surface. When converted to a texture, this opens a Value Texture Editor.

Density
This controls the density of the atmosphere. The greater the number, the thicker the atmosphere, and the more it obscures distant objects. The valid range is 0 or larger, where a density of 0 results in no atmosphere. When converted to a texture, this opens a Value Texture Editor.

Solar Halo Brightness
This controls the brightness of the halo around the sun as it is seen through the atmosphere. This parameter is hidden if the Generator UI Mode preference is set to ‘Simple.’ When converted to a texture, this opens a Value Texture Editor.

Solar Halo Size
This value controls the size of the halo around the sun. This parameter is hidden if the Generator UI Mode preference is set to ‘Simple.’ When converted to a texture, this opens a Value

Texture Editor.

Color
This color dot controls the color of the atmosphere. This color has an effect on how the Color Perspective is interpreted. When this parameter is set to black, the Color Perspective ends up acting a lot like the Water Material Color Opacity parameter.

Color Perspective
These values describe how the atmosphere changes color with distance. These three numbers refer to how fast the Red, Green, and Blue light attenuates with distance, respectively. The valid range is 0 or larger. Using larger values will increase the apparent density. This parameter is hidden if the Generator UI Mode preference is set to ‘Simple.’

Sunset Colors
If this option is checked, the color of the atmosphere changes dependent on the camera’s location relative to the sun. The colors change to simulate sunset or sunrise.

Base Height
This thumb wheel sets the base level of the atmosphere relative to the surface of the planet. Since the density of the atmosphere drops off with distance from the surface, a positive value will create a denser and thicker atmosphere, and a negative value creates a less dense and thinner atmosphere. This parameter is hidden if the Generator UI Mode preference is set to ‘Simple.’

Tip

Set the Base Height of the atmosphere equal to the Sea Level of your Ocean primitive for optimal results!

Clouds & Mist Atmos

This is really the Cloudy Atmosphere object with an extra set of ‘Mist’ controls. It allows you to specify a general atmosphere just like you would use the Cloudy Atmosphere, but also allows you to specify a layer of mist.

Name
The name can be edited. When saving a sky preset to the library, the default name it uses is the one from this name field.

Sun Halo Brightness
This controls the brightness of the halo around the sun as it is seen through the atmosphere. This parameter is hidden if the Generator UI Mode preference is set to ‘Simple.’

Sun Halo Size
This value controls the size of the halo around the sun. This parameter is hidden if the Generator UI Mode preference is set to ‘Simple.’

Sunset Colors
If this option is checked, the color of the atmosphere changes dependent on the camera’s location relative to the sun. The colors change to simulate sunset or sunrise.

Atmosphere
The Atmosphere Control Stack expands to show additional parameters related to the atmosphere. The Height, Density, Color and Color Perspective parameters all behave as described in the Cloudy Atmosphere section above.

Enable
This checkbox is on by default. It can be used to quickly disable the atmosphere rather than changing the

Atmosphere type to ‘None’.

Height
The height of the atmosphere describes how far it expands from the MojoWorld. The greater the value, the further the atmosphere extends into space. The valid range is 0 to 1, where a height of 0 results in no atmosphere and a height of 1 extends the atmosphere one planet radius out from the surface. When converted to a texture, this opens a Value Texture Editor.

Density
This controls the density of the atmosphere. The greater the number, the thicker the atmosphere, and the more it obscures distant objects. The valid range is 0 or larger, where a density of 0 results in no atmosphere. When converted to a texture, this opens a Value Texture Editor.

Color
This color dot controls the color of the atmosphere. This color has an effect on how the Color Perspective is interpreted. When this parameter is set to black, the Color Perspective ends up acting a lot like the Water Material Color Opacity parameter.

Base Height
This thumb wheel sets the base level of the atmosphere relative to the surface of the planet. Since the density of the atmosphere drops off with distance from the surface, a positive value will create a denser and thicker atmosphere, and a negative value creates a less dense and thinner atmosphere. This parameter is hidden if the Generator UI Mode preference is set to ‘Simple.’

Constant Center
The Density parameter specifies how dense the atmosphere is at the Base Height. Above that height, the

atmosphere gets thinner. Below that height, the atmosphere's behavior depends on the Constant Center checkbox. When the Constant Center is unchecked, the atmosphere will get thicker below the Base Height. When Constant Center is checked, the atmosphere will remain at a constant density below the Base Height. This parameter is hidden if the Generator UI Mode preference is set to 'Simple.'

Color Perspective
These values describe how the atmosphere changes color with distance. These three numbers refer to how fast the Red, Green and Blue light attenuates with distance, respectively. The valid range is 0 or larger. Using larger values will increase the apparent density. This parameter is hidden if the Generator UI Mode preference is set to 'Simple.'

Mist
The Mist Control Stack expands to show additional parameters specific to the mist.

Enable
This checkbox is on by default. It can be used to quickly disable the mist rather than changing Atmosphere type to a type without mist.

Color
This color dot specifies the color of the mist. While it can be driven with a color texture, the results will be unpredictable.

Height
The height of the mist describes how far it expands from the MojoWorld. The greater the value, the further the mist extends into space. The valid range is 0 to 1, where a height of 0 results in no mist and a height of 1 extends the mist one planet radius out from the surface. Since the units for the mist are the same as

for the atmosphere, you'll generally want to set this value to well below the value used in the atmosphere section. When converted to a texture, this opens a Value Texture Editor.

Density
This controls the density of the mist. The greater the number, the thicker the mist, and the more it obscures distant objects. The valid range is 0 or larger, where a density of 0 results in no mist. When converted to a texture, this opens a Value Texture Editor.

Base Height
This thumb wheel sets the base level of the mist relative to the surface of the planet. Since the density of the mist drops off with distance from the surface, a positive value will create a denser and thicker mist, and a negative value creates a less dense and thinner mist. This parameter is hidden if the Generator UI Mode preference is set to 'Simple.'

Constant Center
The Density parameter specifies how dense the mist is at the Base Height. Above that height, the mist gets thinner. Below that height, the mist behavior depends on the Constant Center checkbox. When the Constant Center is unchecked, the mist will get thicker below the Base Height. When Constant Center is checked, the mist will remain at a constant density below the Base Height. This parameter is hidden if the Generator UI Mode preference is set to 'Simple.'

Cloud Layer

When you add a cloud layer in the Sky Editor Options menu, another expandable section of the Control Stack appears called “cloud layer.” You may add any number of cloud layers. Options on the new DDLB that appears next to the Control Stack Expander for the Cloud Layer allow you to Delete the Cloud Layer, or Load a Cloud Layer in from the library. Loading in a new Cloud Layer replaces the existing Cloud Layer. Below the separator is an item saying simply, ‘Cloud Layer.’ Selecting this is what creates a new Cloud Layer with parameters that you can edit. More types of Cloud Layers may appear in this section when added as plug-ins, either from Pandromeda or from third party plug-ins. Once a Cloud Layer has been defined, a new option appears in the DDLB between the ‘Delete’ and ‘Load’ items, and that is an option to Save the Cloud Layer to a library file.

Name
Edit the name of the cloud layer to distinguish it from other layers.

Layer Height
This value describes the altitude, in meters, of the cloud layer above sea level.

Cloud Color
This color dot controls the color of the clouds. When changed to a texture, a Color Texture Editor appears.

Cloud Density
This parameter controls the transparency of the cloud layer by increasing and decreasing the density. A value of 0 means there are no clouds; a value of 1 means that clouds are present. This parameter is generally driven by a texture. When changed to a texture, a Value Texture Editor appears.

Enabled
When checked, allows the cloud layer to render.

Cast Shadows
When checked, this parameter allows the cloud layer to cast shadows on the terrain, objects and other clouds. This is dependent on the shadows parameter of the render setting used.

Receive Shadows
When checked this parameter allows shadows to be cast onto the cloud layer. This is dependent on the shadows parameter of the render setting used.

Terrain Avoidance
This value represents a minimum distance between the cloud layer and the MojoWorld surface. Clouds disappear if the terrain gets closer than this distance. This allows high mountains to punch through cloud layers, without seeing the cloud layer intersecting the terrain.

Pick Up Sun Color
When checked, the clouds take on the color of the sun light. This is most effective when the sun light is a saturated color or the ‘Sunset Color’ parameter of the Sun Light object enabled.

Uniform Fog

The Uniform Fog atmosphere does not support clouds, so any Cloud Layers that are present will not render. This is a very simple atmosphere model.

Name
The name can be edited. When saving a sky preset to the library, the default name it uses is the one from this name field.

Type
The choices for Type are Exponential and Exponential Squared.

Density
This controls the density of the fog. The greater the number, the thicker the fog, and the more it obscures distant objects. The valid range is 0 or larger, where a density of 0 results in no atmosphere.

Color
This controls the color of the fog.

Basis Function Reference

Basis Functions are used as sub plug-ins to many of the Fractal nodes, usually as the last parameter on the Fractal node's control stack. Additional Basis Functions may appear on these DDLBs when added as plug-ins, either from Pandromeda or from third party plug-ins.

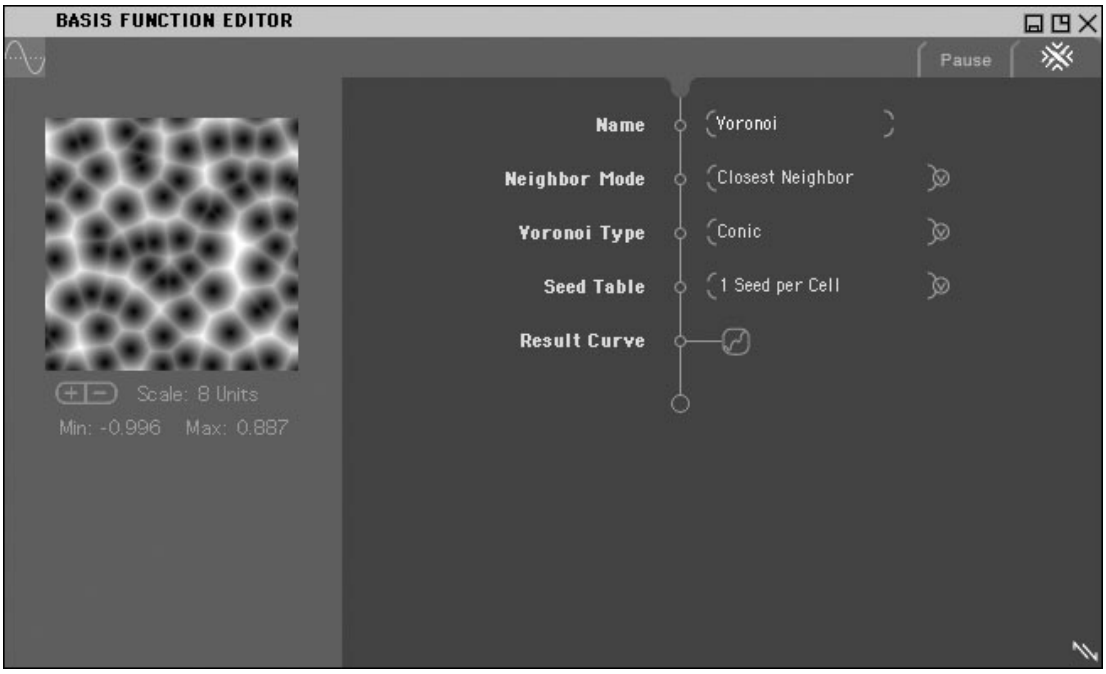
Many of the Basis Functions have been discussed in the MojoWorld Theory section. This reference is a practical guide to the parameters found in the Basis Function Editor for each of the Basis Functions. It also shows how the various Basis Functions are related.

The choice of what Basis Function to use in your Fractal nodes is the factor which will most affect the resulting shape of your terrain, or the layout of colors in a material or the amount of displacement, or the density of the clouds or pretty much any parameter there is in MojoWorld that can be driven with a fractal. Color textures are the most forgiving − any basis function will work fine (though there may be aliasing concerns for animations).

Land textures are quite unforgiving. When choosing Basis Functions for shaping the terrain, it is suggested to use the smoother ones. Sharp edges, such as those found in the Steps, Checkerboard and some variants of Voronoi (lozenge, for one) and Sparse Convolution (the disks and dishes kernels) will be prone to missing blocks during renders and slow render times due to the vertical edges.

The Basis Function Editor

The Basis Function Editor consists of a simple 2D preview on the left, and the Basis Function Control Stack on the right.



The Preview on the left samples the noise using a 2D plane. You can zoom in and out to see the noise at different scales, and there are text readouts that show the current range of values the basis function is generating over the preview scale.

Parameters on the Control Stack are different for each basis function. All basis functions have a “Result Curve” that lets you remap the output in any way. The basis functions are for the most part designed to generate values of the range -1.0 to 1.0 (one notable exception is that the Sparse Convolution basis generates values that are always larger than 0). The fractals expect a -1.0 to 1.0 range, so keep this in mind when altering the curve.
The following reference of the different Basis Functions is in a different order than they are found in the Basis Function sub plug-in slot of the

Fractal nodes. Rather than listing each Basis Function individually, they will be discussed in sets to emphasize their relationships.

The sets are:

Checkerboard • Sine

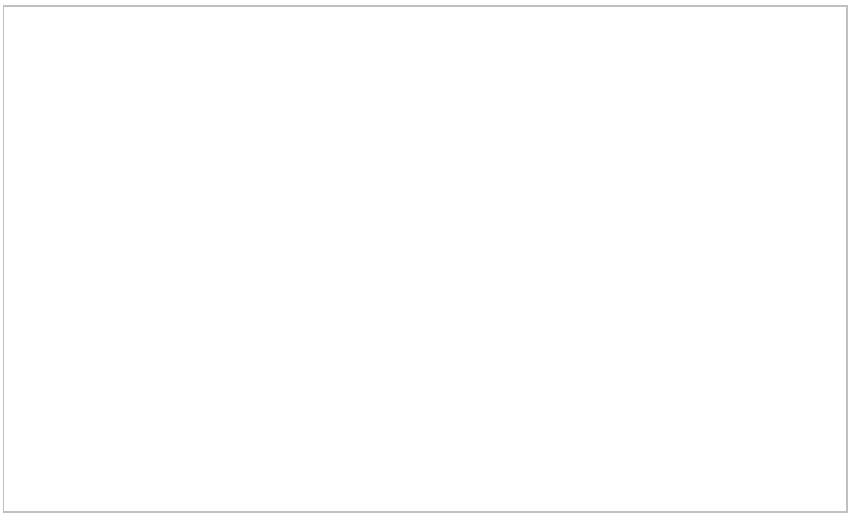
Steps • Steep Steps • Linear

Value Perlin • Value/Gradient Perlin • Variable Value/GradientPerlin • Gradient Perlin

Ridged Value • Ridged Value/Gradient • Ridged Variable Value/Gradient • Ridged Gradient

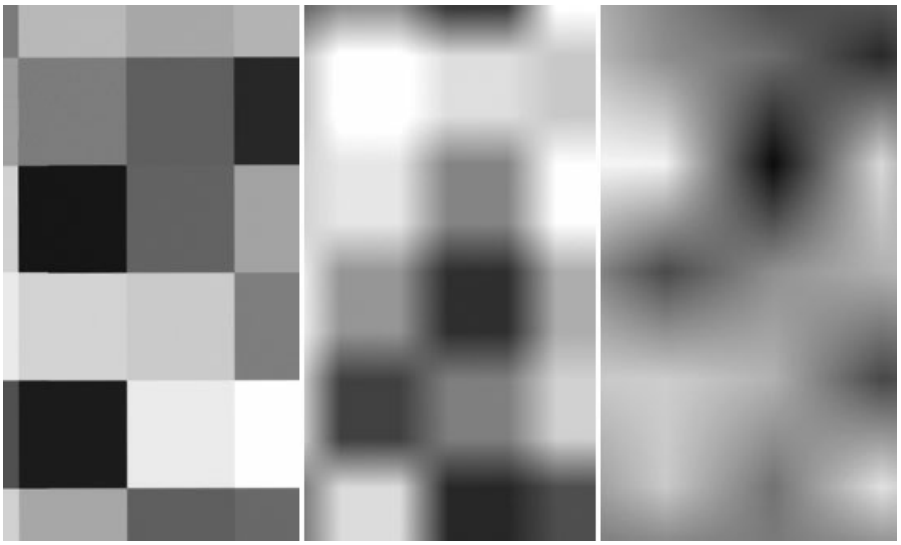
Checkerboard • Sine

These two Basis Functions are simple wave forms. The Checkerboard is made from a square wave and the Sine is made from a sine wave. Both have only a Result Curve parameter in the Basis Function Editor Control Stack.
There are two caveats about the Checkerboard noise. The first is that the noise does not properly mirror itself across the origin, so when using a simple Checkerboard noise in Object Position on a primitive or model may show bands that are two squares wide. Use the Offset parameter of the Noise or Fractal node to re-locate the origin. The second caveat also relates to using a simple Checkerboard noise in Object Position on a box primitive. When the boundary between cubes perfectly lines up with the edges of the box primitive, the values returned appear as random noise. Again, use the Offset parameter of the Noise node to move the noise so that it does not perfectly coincide with the planes of the primitive.



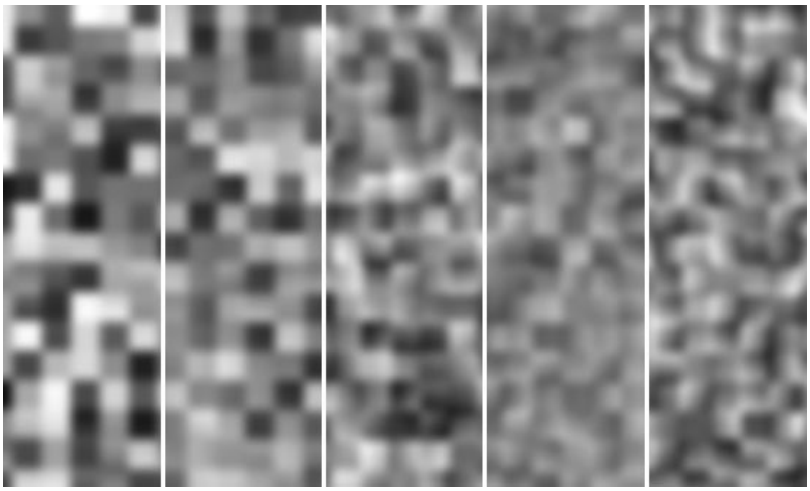
Steps • Steep Steps • Linear

The Steps Basis Function creates a regular pattern of squares of random heights. The Linear Basis Function produces a faceted style noise by connecting randomly chosen height values with straight edges. Both have only a Result Curve parameter in the Basis Function Editor Control Stack. The Steep Steps Basis Function creates a regular pattern of squares of random heights, with a controllable blended boundary between each square. That boundary is controlled with the Slope Width parameter. A Slope Width of 0 produces the same result as the Steps Basis Function and a Slope Width of 2.0 produces the same result as the Linear basis function. The default value for Slope Width is 0.02, producing rather sharp squares. The sample shown in this image has its Slope Width set to 0.9.



Value Perlin • Value/Gradient Perlin • Variable Value/Gradient Perlin • Gradient Perlin

Perlin noise is named after Ken Perlin, who developed the algorithm. The original Perlin noise is Gradient Perlin, which creates a smoothly varying noise by interpolating values between randomly chosen slopes. Value Perlin is a simpler variation of the Perlin noise which creates a smoothly varying noise by interpolating between randomly chosen values. The Value/Gradient Perlin noise uses both methods and blends the result. All three of those variations have only a Result Curve parameter in the Basis Function Control Stack. The Variable Value/Gradient Perlin noise combines the Value and Gradient types based on the Gradient/Value Proportion parameter. A Gradient/Value Proportion of 0 results in pure Value Perlin noise. A Gradient/Value Proportion of 1 results in pure Gradient Perlin noise. The default of 0.5 gives the same result as the Value/Gradient Perlin noise. The five samples shown in the image below from left to right are as follows: on the left is Value Perlin, then a Variable Value/Gradient Perlin with the Gradient/Value Proportion parameter set to 0.25, in the center is the Value/Gradient Perlin, then a Variable Value/Gradient Perlin with the Gradient/Value Proportion parameter set to 0.75, and lastly on the right is the Gradient Perlin.



Tip

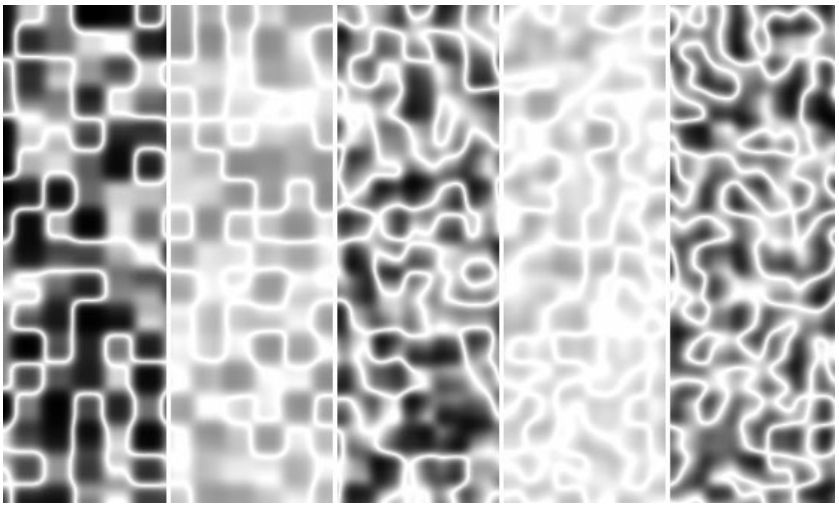
A crude but helpful analogy to explain the difference between Value and Gradient is to imagine a chessboard with lumps of clay of varying sizes in each square. Imagine each lump carefully centered and you have an approximation of Value Perlin. Now imagine pushing each lump off-center by varying amounts and in different directions. This approximates Gradient Perlin. A more accurate analogy would include dimples as well as lumps.

Ridged Value • Ridged Value/Gradient • Ridged Variable Value/Gradient •

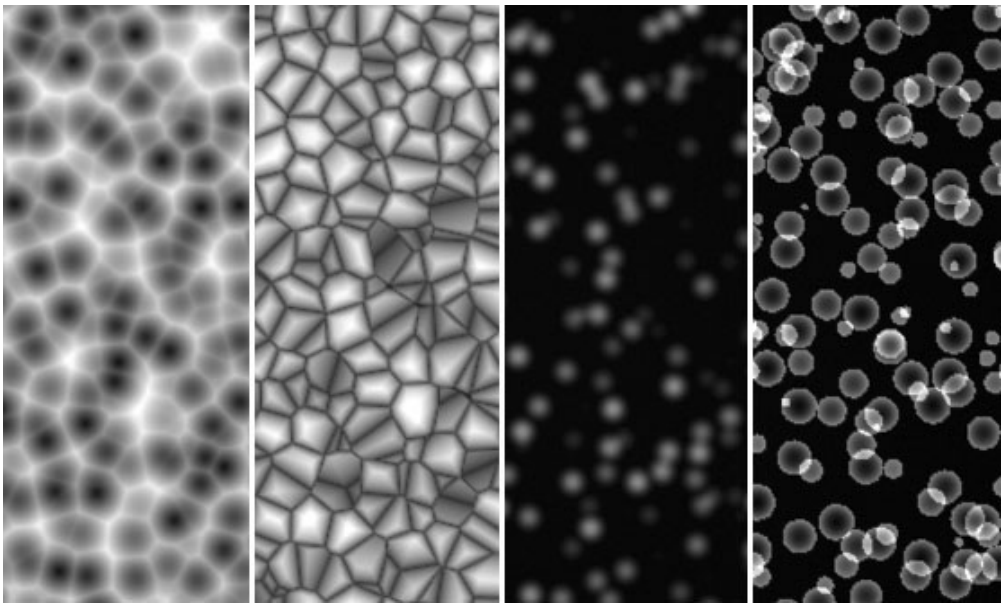
These basis functions use the appropriate Perlin style basis function and then create ridges by taking the absolute value of the result. See the Basis Function section of the Theory chapter for more detail. The parameters are identical to the non-ridged versions of these basis functions. The five samples shown in the image here from left to right are as follows: on the left is Ridged Value, then a Ridged Variable Value/Gradient with the Gradient/Value Proportion parameter set to 0.25, in the center is the Ridged Value/Gradient, then a Ridged Variable Value/Gradient with the Gradient/Value Proportion parameter set to 0.75, and lastly on the right is the Ridged Gradient.

Note that the two Ridged Variable Value/Gradient samples are noticeably lighter than the other versions of the Ridged basis functions. This is unfortunately due to some code which was left in by mistake (so technically it's a bug) that was intended to adjust the output range. However, changing the output of this basis function would dramatically change existing worlds which use it. It's not a critical problem, just be aware that the output range of the Ridged Variable Value/Gradient Basis Function is not centered on 0.

When used in land textures and in conjunction with large displacements from the land material, the sharp ridges found in the Ridged family of basis functions can result in render artifacts. A work-around for this is to use the corresponding Perlin variant and use a Result Curve to remap the values smoothly at the peak. A suitable curve can be found in the Curves preset library.



Voronoi • Sparse Convolution



These two Basis Functions share the same Seed Table data. The image shows four examples of the many possible variations of the seed table bases, two Voronoi and two Sparse Convolution. Other than the Seed Table, the two have very different parameters, so each follows with its own reference.

Voronoi
This basis function produces various styles of noise by dividing space up into cells, then randomly placing one or more points in each cell. The distance to these random points and the type of noise decides the return value.

Parameters
• Neighbor Mode
Selects which neighbor(s) to use for the distance calculation. There are options for a single close neighbor, and for the difference between two close neighbors.

• Voronoi Type
Selects what calculation to perform on the distance to the neighbor(s). There are two possible sets of options here, depending on whether you've selected a single neighbor mode (Closest, 2nd Closest, etc), or a mode involving two neighbors (1st and 2nd Closest, 2nd and 3rd Closest, etc).

Single Neighbor Modes

1) Lozenge - assigns a random value to each random point, and returns the value from appropriate closest neighbor. This gives flat interlocking randomly shaped regions.

2) Conic - returns the actual distance to the appropriate neighbor. This creates a cone shape around each of the random points.

3) Parabola - returns the distance squared to the appropriate neighbor. This creates a parabolic dish around each point, with a smoothly varying shape

Multiple Neighbor Modes

1) Difference - returns the difference between the distances to the two chosen neighbors. This creates random height lumps surrounded by a border.

2) Difference Squared - returns the square of the difference between the distances to the two chosen neighbors. The result is similar to Distance mode, but with sharper ridges and steeper edges.

• Seed Table
Selects what table of random numbers to use to place the neighbor points. Refer to the Theory chapter for more information on the different seed tables.

Sparse Convolution

This basis function uses the same seed tables as the Voronoi basis to divide space up into cells, and places random points in each cell. Each random point is then used as a position to place a given shape, and the result is obtained by adding up all the shapes at the various random points.

Parameters

• Splat Kernel

Chooses what shape to apply at each random point.

• Kernel Radius

Determines how big the shapes at each random point are. Small values will create many small isolated details, larger values will make the shapes overlap and create more complex continuous results.

• Seed Table

Selects what table of random numbers to use to place the shapes in each cell. Refer to the Theory chapter for more information on the different seed tables.

Distorted Noise

This basis function doesn't fit in any of the previous groupings because it isn't really a single basis function, but rather is an interaction between any two of the other basis functions. Creates complex basis functions by using one basis as a domain distortion for another basis. In the same way as the Texture Editor allows you to use domain distortions to distort the space of a fractal, the Distorted Noise does this on the individual noise functions from which the fractals are built. Note that this noise must be edited in order to specify the initial basis functions before it will produce any output, as it defaults to no noise at all. While it's possible to distort one basis with a differently scaled version of the same basis, doing so will create some rather significant aliasing effects and therefore is not recommended.

Parameters

- Distortion Size

Controls the size of the features of the basis function used for the domain distortion. Values less than 1.0 will give high frequency distortions smaller than the size of the primary basis function features, values larger than 1.0 will give distortions that spread out over progressively larger regions.

- Distortion Amount

Controls how much the space is distorted. A value of 0.0 will produce no distortion, and larger values will produce ever more extreme distortions

- Basis Function

The actual basis function that will be used to return the value. This defaults to 'None' so the distorted noise will produce no output until a basis function is selected.

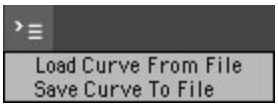
- Distortion Basis

The basis function that will be used to distort the space of the noise.

The Curve Editor Reference

The Curve Editor Title bar does not have the standard Stow, Maximize, and Close buttons because it is a modal dialog. No other parts of the MojoWorld interface are active while a Curve Editor is open. The RTR and Zip Render Window will both pause while you are working in a Curve Editor.

The next row has a Curve Editor Icon, an Options Menu icon, and then Cancel and OK buttons on the right. The Curve Editor must be dismissed with either the Cancel or OK buttons before you can resume working in MojoWorld. Click the Cancel button to exit the Curve Editor without making any changes. Click the OK button to accept your Curve Editor changes and apply them to your MojoWorld.



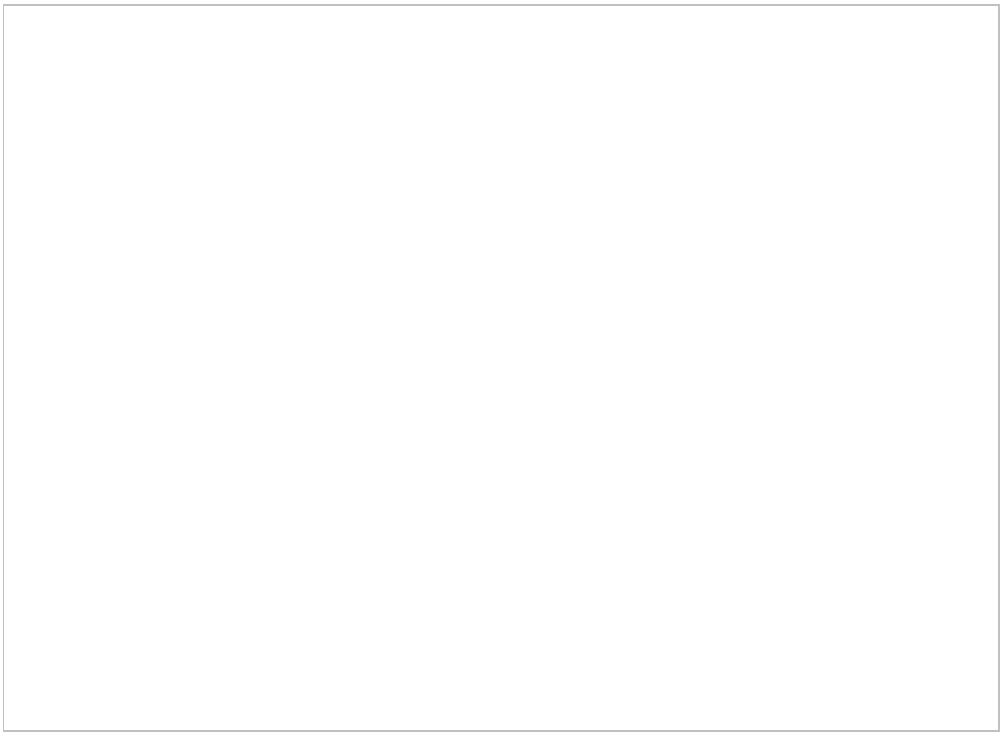
Curve Editor Options Menu
The Curve Editor Options Menu allows you to save your curves to the Library or load curves in from the Library.

Save Curve to File
This option opens a Library Exporter to save the current Curve to a library file. This saves not only the curve shape and all of its control points, but also saves the settings of all the parameters on the Control Stack. See the Library chapter for more information on the Library Exporter dialog.

Load Curve from File
This option opens a Library Importer to load a curve in from the Library. This will load in not only a curve shape with new control points, but also will load in the settings for the parameters on the Control Stack that were saved with the original curve.

On the left of the Curve Editor is a graph. On the right of the Curve Editor parameter area is a Control Stack.

When the Curve Editor opens for the first time, the curve is a straight line going from the bottom left to the top right. The Min Input and Min Output are both set to 0. The Max Input and the Max Output are both set to 1. The Beyond Input DDLB is set to ‘Continue’ and the Beyond Output DDLB is set to ‘No Change.’ The combination of all of these default elements have the end result that the curve has no effect on the values flowing through it: input values are mapped to exactly the same output value, even when those values are outside of the 0 to 1 Input range. A value of 0.5 comes out as 0.5, a value of -100 comes out as -100, a value of a million comes out as a million.



If the curve is not the default diagonal, or if the Min Input and Min Output are not equal to each other, or if the Max Input and the Max Output are not equal to each other, or the Beyond Input DDLB is set to something other than ‘Continue,’ then input values are mapped to some different output value — possibly to a very significantly different output value!

To shape the graph, use the tools in the bar beneath the graph. The control points can be selected and moved with your mouse. The end points cannot be moved horizontally, they can only be slid up and down along the left and right edges of the graph area.

The plus and minus icons add and subtract control points to the curve. Neither end point can be removed. When a control point is selected, white Slope Handles appear which can change the slope of the curve around the control point. To change the two sides independently, first click on the break tool and then click on the point handle. The handles now turn pink and can be moved independently. The break tool has no visible effect on the end points of the curve. To zoom in or shift the range of the graph, use the range/zoom controls on the sides of the graph box.
The Flip Horizontal and Flip Vertical buttons create mirror images of your graph about lines bisecting the graph through the center point.

The Reset Curve button changes the shape of the curve back to the default diagonal with only the two control points at either end.

Below the tools are fields for Input and Output. These fields show readouts when mousing over the graph area with the Add Point or Delete Point tool selected, or when any individual point is selected with the Move Point tool. When a point is selected, values may be typed into these fields to position the point precisely within the graph area. If the value typed in is out of the range specified for the Input or Output, the value will be clamped accordingly.

Curve Editor Control Stack

On the right of the Curve Editor Parameter area is a Control Stack. Above the Control Stack will be a set of three icons for each channel handled by the curve. A curve may only have a single channel, such as the Altitude, or the output of a fractal. Some curves may have three channels, one each for Red, Green and Blue output. Of these three channel-specific icons above the Control Stack, the first icon is a number to indicate which channel the icons affect. The second icon is the eyeball icon which can be used to hide or reveal the different curves. When a curve is hidden, it still affects the data. The third icon is the Bypass icon. It can be used to temporarily return the curve to the default diagonal, though the data will still be affected by the Min/Max Input and Output ranges, and the settings of the Beyond Input and Beyond Output DDLBs. When a curve is being bypassed, a straight diagonal will be drawn and the curve's actual shape will be shown as a dashed curve.

Min Input/Max Input
These Thumb Wheels control the range of the input, or x-axis, of the graph. Because the Curve Editor occurs in so many different places in the MojoWorld interface, it's important to know the source of the curve's input.

Beyond Input
This DDLB controls the behavior of the graph outside the range of input values displayed in the Graph Window.

> **Continue**
> Extrapolates the graph at the point it leaves the range in both the negative and positive directions. Think of the graph as continuing in a straight line at the slope it was at, at the edge of the Graph Window.
>
> **Clamp**

Fixes any values outside of the range of the graph to the last value within the range. Think of the graph continuing as a horizontal line beyond the edges of the Graph Window.

Mirror
Bounces the graph back into the Graph Window when the curve goes above the top edge of the Graph Window or below the bottom edge.

Repeat
The graph is repeated for values outside the left and right edges of the Graph Window.

Bind Output
Applies the Beyond Output rules to any input that falls outside of the Input range.

Min Output/Max Output
These Thumb Wheels control the range of the output, or y-axis, of the graph. Because the Curve Editor occurs in so many different places in the MojoWorld interface, it's important to know how the output of the curve will be used further down the data flow pipeline.

Beyond Output
This DDLB controls the behavior of the graph outside the range of output values displayed in the Graph Window.

Unchanged
If the curve goes out of the top or bottom of the Graph Window, the values returned are interpolated along the portions of the curve that are not visible.

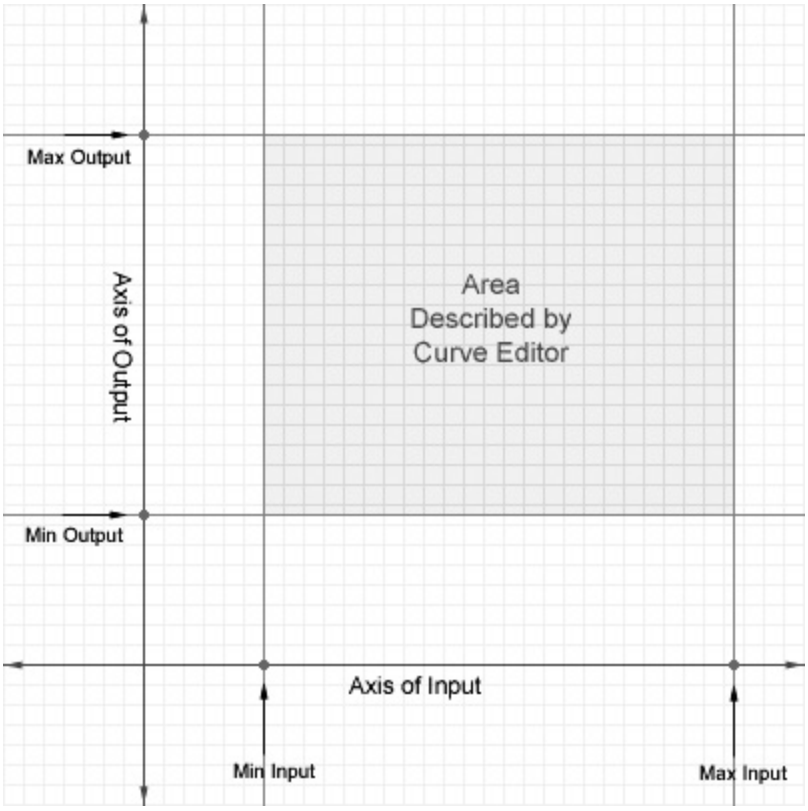
Clamp
Where the curve in the Graph Window goes out the top or bottom of the Graph Window, values are set to the Max Output or Max Input values, respectively. This clamping applies only to the data within the input range. Data outside of the input range

will not be clamped unless the Beyond Input DDLB is set to something other than ‘Continue.’

Reflect
Where the curve in the Graph Window goes out the top or bottom of the Graph Window, the curve gets bounced back into the Graph Window. This reflecting applies only to the data within the input range. Data outside of the input range will not be reflected unless the Beyond Input DDLB is set to something other than ‘Continue.’

The Graph Area

The curve editor works just like graph paper. The Min Input and Max Input specify the left and right hand boundaries and the Min Output and Max Output specify the top and bottom boundaries. All curves have at least two control points. These two points are attached to the Min Input and Max Input sides of the graph editing area. New points can be added within the graph editing area, but the two end points will always be constrained to moving up and down along their respective edges of the graph. These control points are referred to below as the Min Input control point and the Max Input control point.



Although the curve editing area of the Curve Editor is square, the mathematical area represented by the input and output ranges may define an area that, while rectangular, is far from being square. For example, if the Min Input and Max Input are 0 and 1, but the Min Output and Max Output are -1000 and 3000, that would represent a

very tall and skinny area on a sheet of graph paper. The curve editor reshapes that conceptual area into a square.

Input Sources and Output Uses

To effectively use the Curve Editor, it's important to know what sorts of values might be going into the curve's input and what sorts of values are appropriate for where the curve's output is used.

Much of the time, the data going into the curve comes from the output of a fractal node. The output of a fractal node will depend on a lot of things, but the primary indicator is the fractal's Result Scale parameter. A relatively safe assumption is that the output of a fractal node will range between plus and minus its Result Scale. So, for a fractal node with a Result Scale of 1, the output will probably be in the range of -1 to 1. For a fractal node with a Result Scale of 2000, the output will probably be in the range of -2000 to 2000. Note that's a very generalized rule − the actual output will depend a lot on what Basis Function the fractal node uses. The other parameters of a fractal node can also have a significant effect on the node's output. But for the purposes of setting up a suitable Curve, having a general idea of what the output may be is enough to get started.

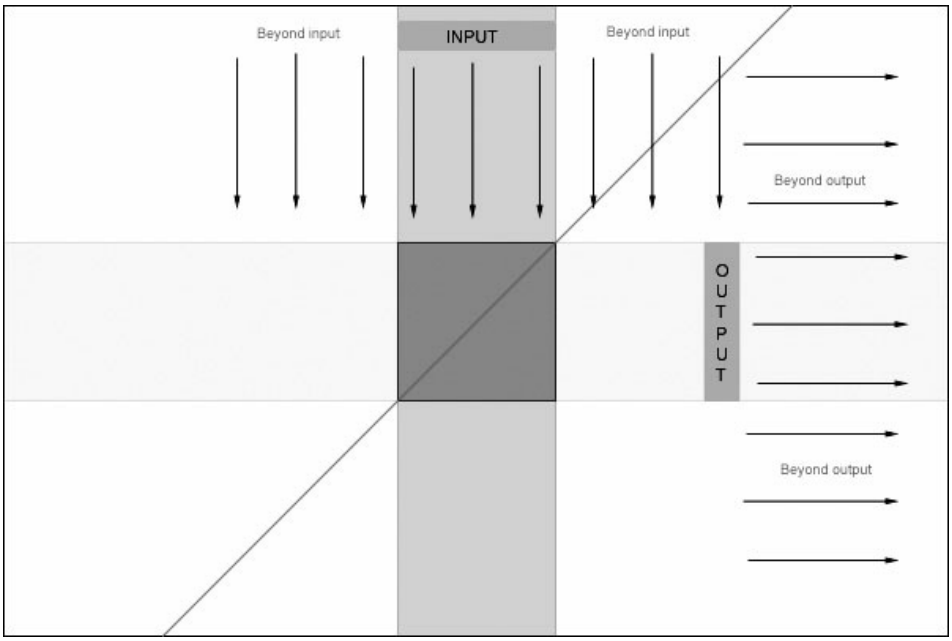
Sometimes the data going into the Curve doesn't pass through a fractal node at all, but instead is the raw Altitude or Slope of the terrain. If it's the Slope, you can be certain that the input will always be no less than -1 and no more than 1 just by the definition of what Slope is. If it's the Altitude, you can get some idea of what the range of values is by looking at the readouts below the preview swatches in the land texture editor.

After you have an idea of what's going into the curve, you have to know what you're doing with the data when it leaves the curve. There are many circumstances when the default 0 to 1 range is exactly what is needed. Those include (but probably aren't limited to) when the next step for the data is a color gradient, or determines a blend, or drives the density of a cloud layer. Not all outputs will be suited to a 0 to 1 range, however. If the output is going to create mountains, for

example, it should be a much larger range of values.

One Step Beyond

The following diagram represents the default state of the Curve Editor. The small grey square in the middle represents the actual curve editing area. The grey vertical swath down the center represents all possible input values that are in between the Min Input and Max Input parameters. If you've played with the curve editor much, you'll probably have noticed that it won't 'fold over' on itself. Every unique input value must map to one and only one output value. The grey horizontal swath represents all possible outputs that are between the Min Output and Max Output parameters. The diagonal line is the default curve and it extends outside of the curve editing area to infinity because both of the Beyond DDLBs are set to their default values of Continue and No Change.

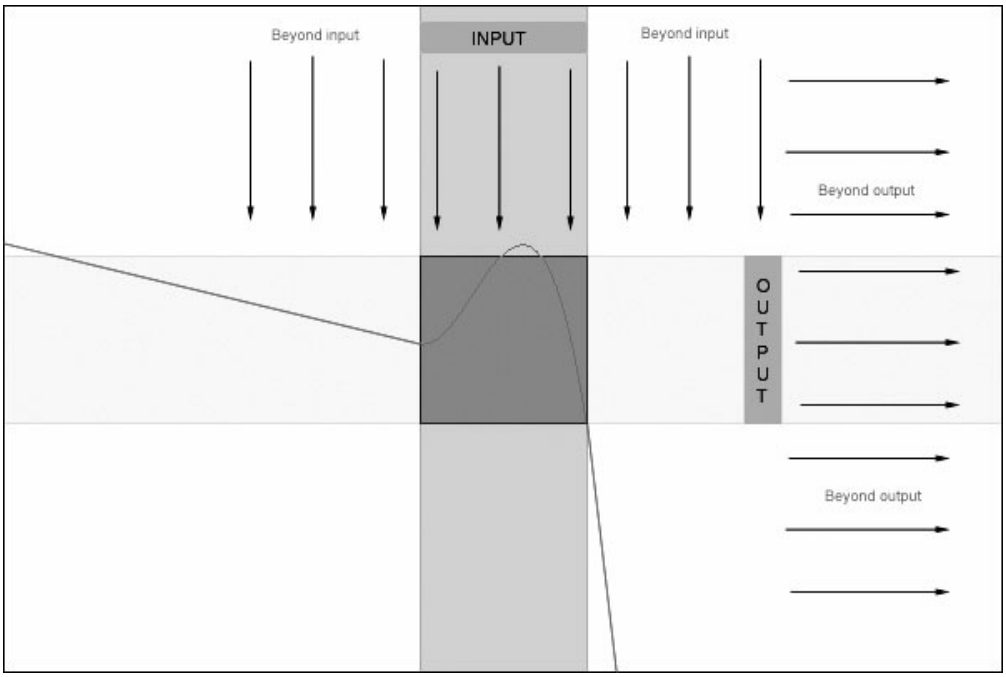


This reference graphically documents the effects of the options in both the Beyond Input and Beyond Output DDLBs in the curve editor. Because the result of the various menu options are so similar for the default curve shape, every possible combination of the two DDLBs is shown below with two curves − first with the default diagonal line and

again with a bendy curve. The Beyond Output options are much more obvious when the effect on the bendy curve is examined.

The bendy curve has its Min Input control handle at a shallow angle and positioned at about the middle of the output range. The Max Input control handle of the bendy curve is at a steep angle and positioned at the Min Output. The positions and angles of these two control handles will be important to diagraming the behavior of the Beyond Input DDLB options. Another effect of the way the handles of these control points are angled is that the bendy curve has a portion that pokes out above the Max Output edge of the graph editing area. This portion of the curve is key to diagraming the behavior of the Beyond Output DDLB options.

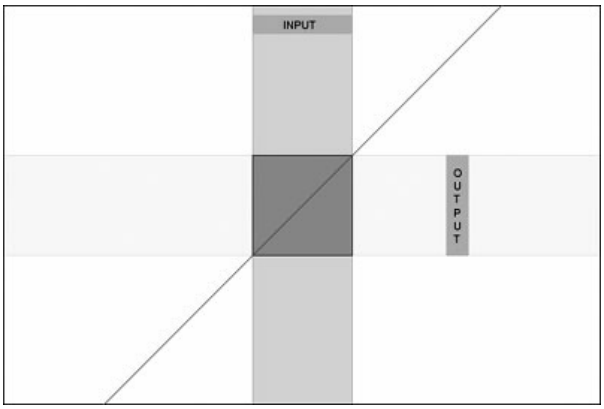
The next diagram shows the bendy curve with the Beyond DDLBs set to their default values of Continue and No Change. Because the Beyond Input is set to Continue, the curve is extrapolated as a straight line which continues along at the same angle as the control handle at either end of the curve. In this diagram, where the input values are less than the Min Input, they are re-mapped to gradually increasing output values because of the shallow angle of the Min Input control point handle. Where the input values are larger than the Max Input, they are very rapidly re-mapped to decreasing output values because of the steep angle of the Max Input control point handle. Because the Beyond Output is set to No Change, the small portion of the curve which goes above the Max Output is not changed.

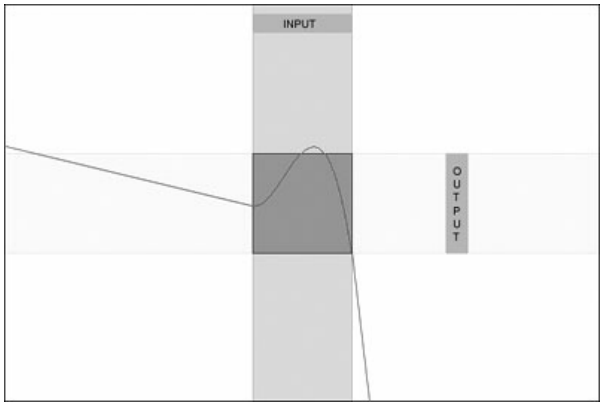


The Reference that follows all use smaller diagrams taken from the larger ones shown above. For many of the entries, the diagrams will look exactly the same!

In this first table, the Beyond Input DDLB is set to ‘Continue’ and the Beyond Output DDLB is set as indicated. For both the straight line curve and the bendy curve, the sections to either side of the input range continue along at the angle set by the control handles on the two end points of the curve. The effects of the Beyond Output options apply only to the data within the specified input range.

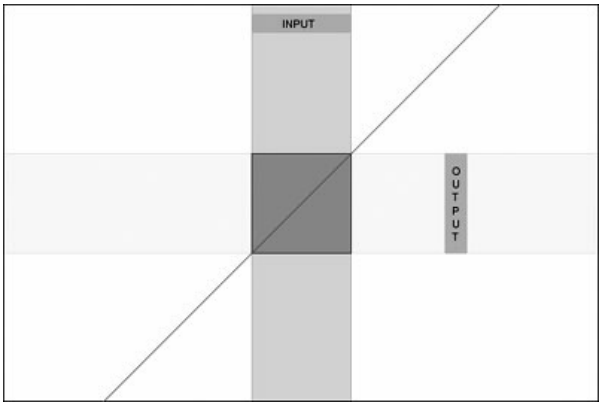
No Change: This is the default configuration for the Curve Editor and these two diagrams are the same as the two larger ones in the top section.

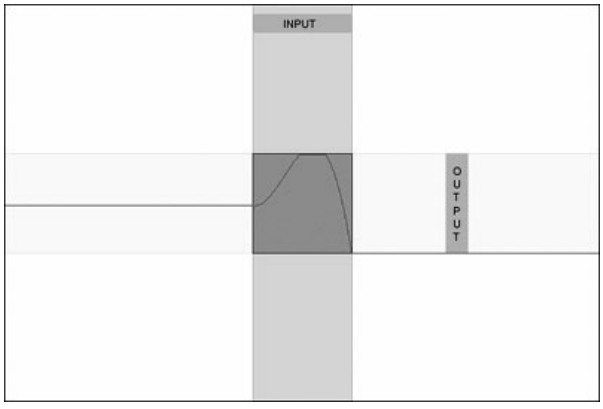




Beyond Input = Continue
Beyond Output = No Change

Clamp: With Beyond Output set to Clamp, the only values which get clamped are those within the input range which go beyond the output range. The straight line curve is not affected. The only change to the bendy curve is that the peak of the curve which pokes out above the Max Output value in the default configuration gets clamped to Max Output. Values outside of the input range are remapped according to how the lines which continue along the angles specified by the control handles on the Min Input and Max Input control points.

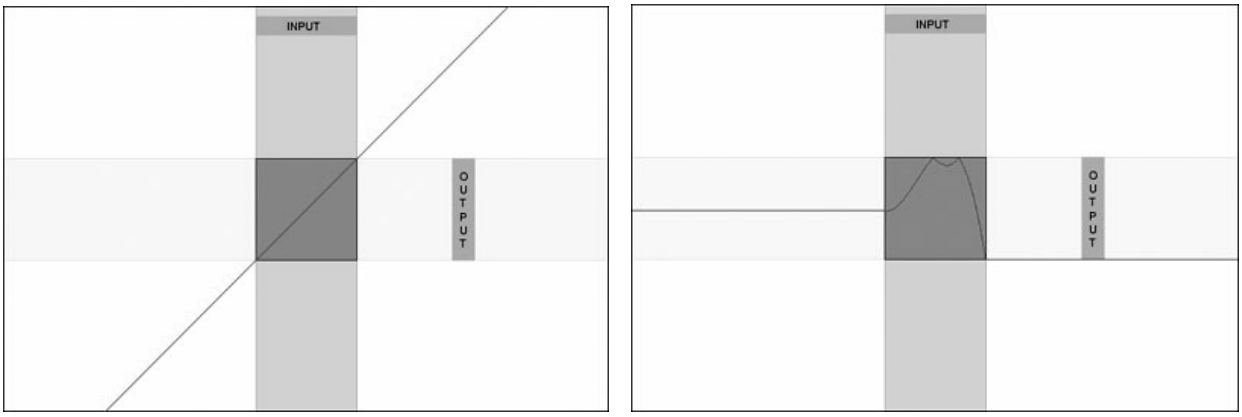




Beyond Input = Continue
Beyond Output = Clamp

Reflect: With Beyond Output set to Reflect, the only values which get reflected are the ones that are in the input range which go beyond the output range. The straight line curve is not affected. The only change to the bendy curve is that the peak of the curve which pokes out

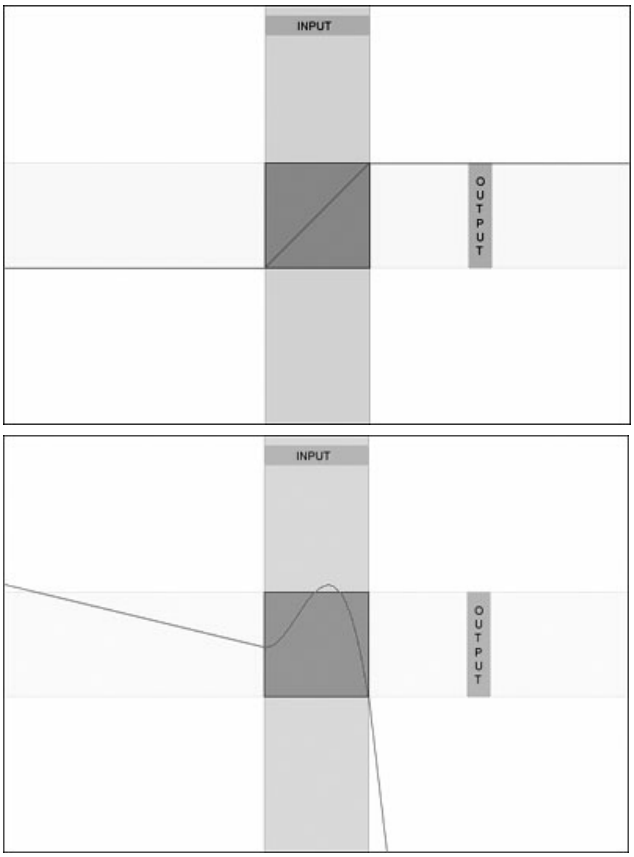
above the Max Output value in the default configuration gets reflected back into the main curve editing area. Values outside of the input range are remapped according to how the lines which continue along the angles specified by the control handles on the Min Input and Max Input control points.



Beyond Input = Continue
Beyond Output = Reflect

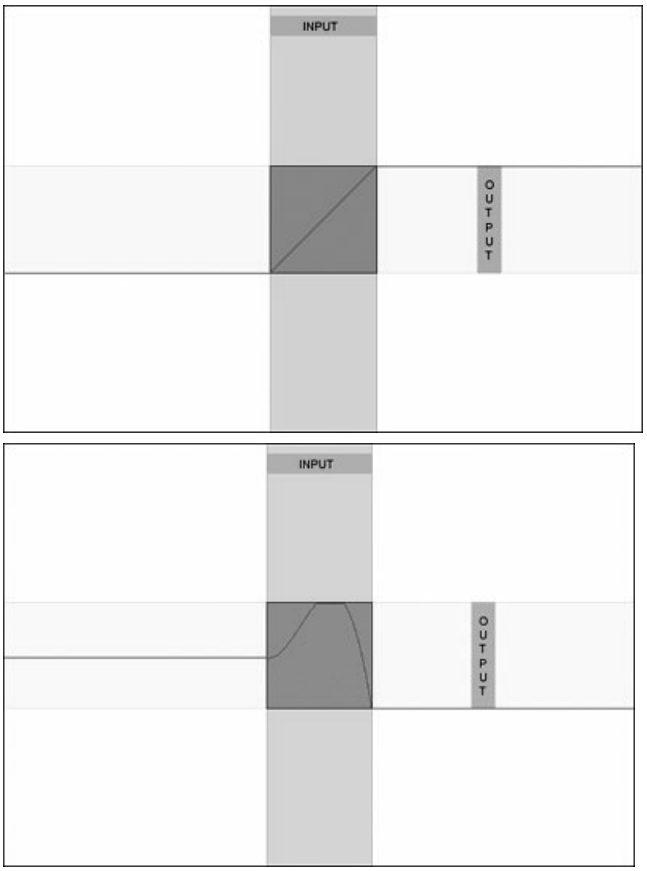
In this second table, the Beyond Input DDLB is set to ‘Clamp’ and the Beyond Output DDLB is set as indicated. For both the straight line curve and the bendy curve, the sections to either side of the input range are clamped to the value at which the respective end points of the curve are set.

No Change: With the Beyond Input set to Clamp, any input that is outside of the input range gets set to the value specified by the end point on either end of the curve. With the Beyond Output set to No Change, any portion of the curve that is within the input range and extends outside of the curve editing area is not changed.



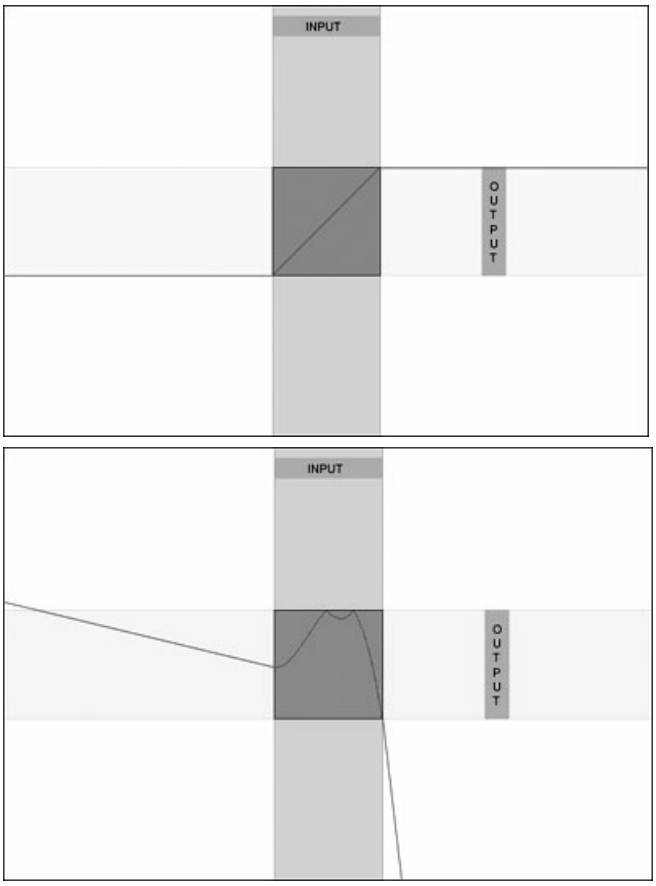
Beyond Input = Clamp
Beyond Output = No Change

Clamp: With the Beyond Input set to Clamp, any input that is outside of the input range gets set to the value specified by the Min Input and Max Input control points. In addition to this clamping of the input, with the Beyond Output also set to Clamp, the peak of the curve which pokes out above the Max Output value in the default configuration gets clamped to Max Output.



Beyond Input = Clamp
Beyond Output = Clamp

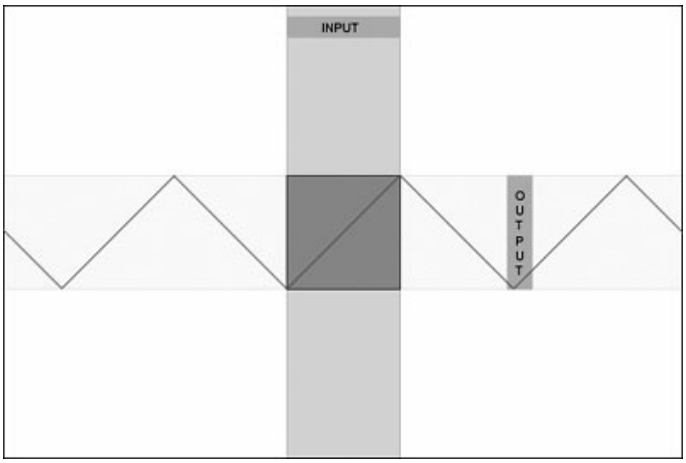
Reflect: With the Beyond Input set to Clamp, any input that is outside of the input range gets set to the value specified by the Min Input and Max Input control points. With the Beyond Output set to Reflect, the peak of the curve which pokes out above the Max Output value in the default configuration gets reflected back into the main curve editing area.

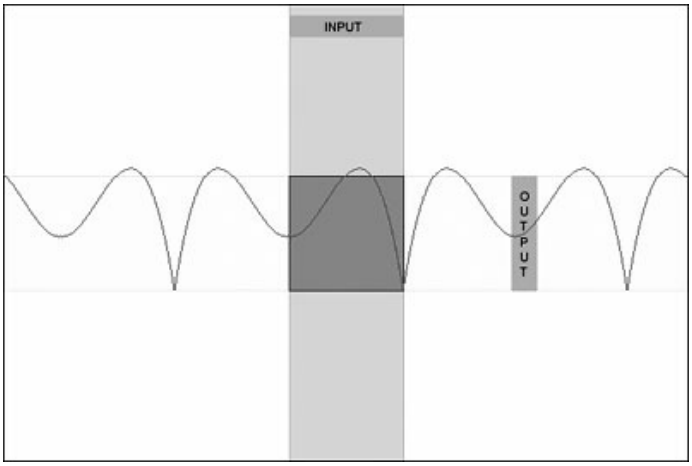


Beyond Input = Clamp
Beyond Output = Reflect

In this third table, the Beyond Input DDLB is set to ‘Mirror’ and the Beyond Output DDLB is set as indicated. For both the straight line curve and the bendy curve, the sections to either side of the input range are filled with mirror image copies of the curve editing area.

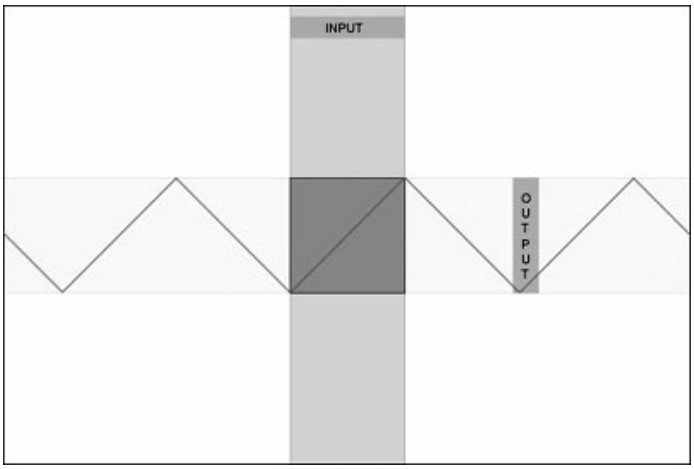
No Change: With the Beyond Output set to No Change, the portion of the curve which pokes out above the Max Output is unchanged in not only the section defined by the input range, but also in all of the mirror copies.

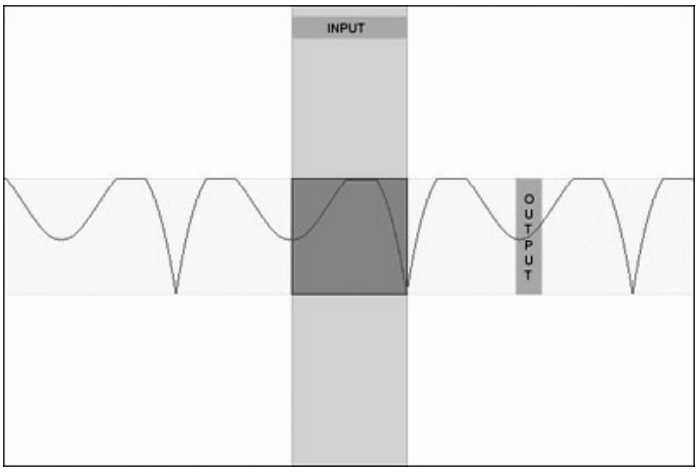




Beyond Input = Mirror
Beyond Output = No Change

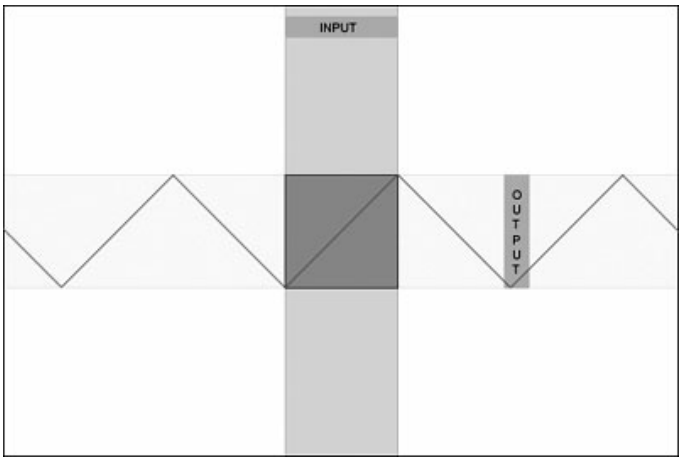
Clamp: With the Beyond Output set to Clamp, the portion of the curve which pokes out above the Max Output is clamped in not only the section defined by the input range, but also in all of the mirror copies.

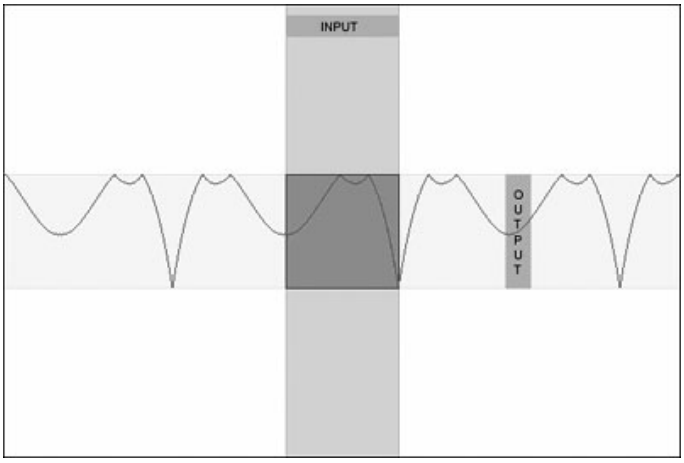




Beyond Input = Mirror
Beyond Output = Clamp

Reflect: With the Beyond Output set to Reflect, the portion of the curve which pokes out above the Max Output is reflected in not only the section defined by the input range, but also in all of the mirror copies.

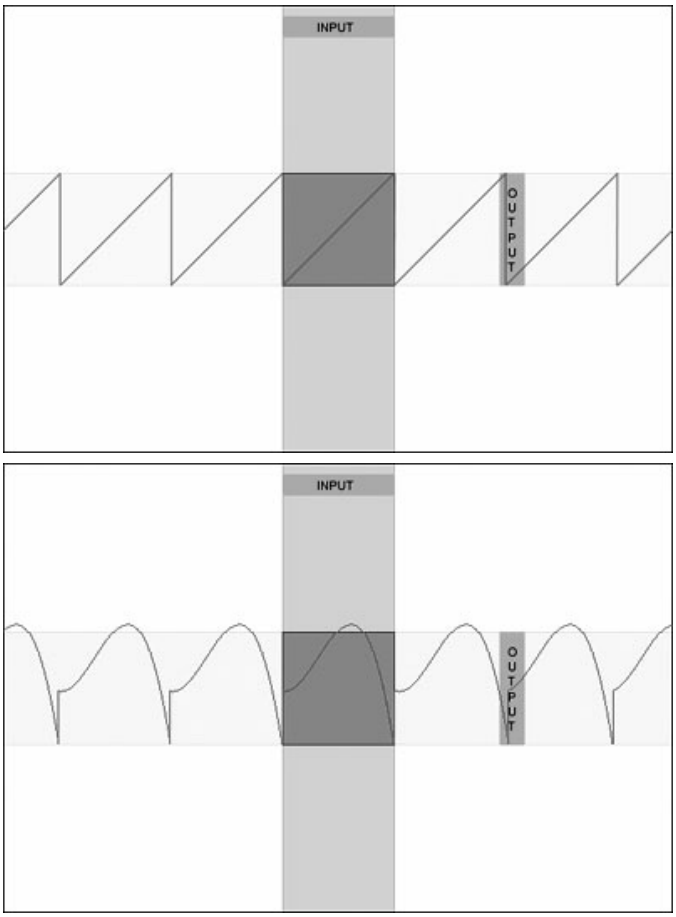




Beyond Input = Mirror
Beyond Output = Reflect

In this fourth table, the Beyond Input DDLB is set to ‘Repeat’ and the Beyond Output DDLB is set as indicated. For both the straight line curve and the bendy curve, the sections to either side of the input range are filled with repeating copies of the curve editing area.

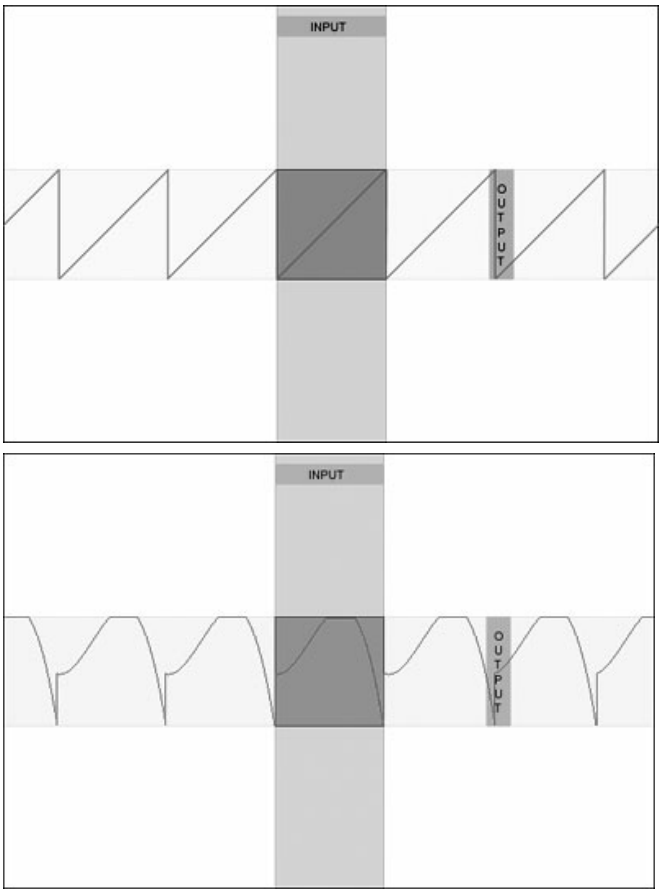
No Change: With the Beyond Output set to No Change, the portion of the curve which pokes out above the Max Output is unchanged in not only the area within the input range, but also in all of the repeated copies.



Beyond Input = Repeat
Beyond Output = No Change

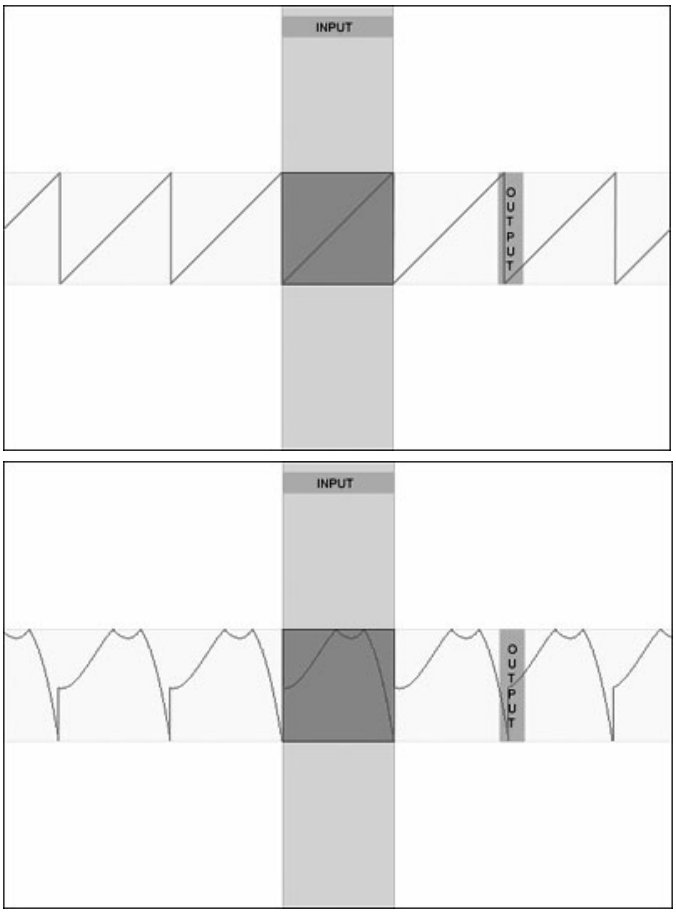
Clamp: With the Beyond Output set to Clamp, the portion of the curve

which pokes out above the Max Output is clamped in not only the area within the input range, but also in all of the repeated copies.



Beyond Input = Repeat
Beyond Output = Clamp

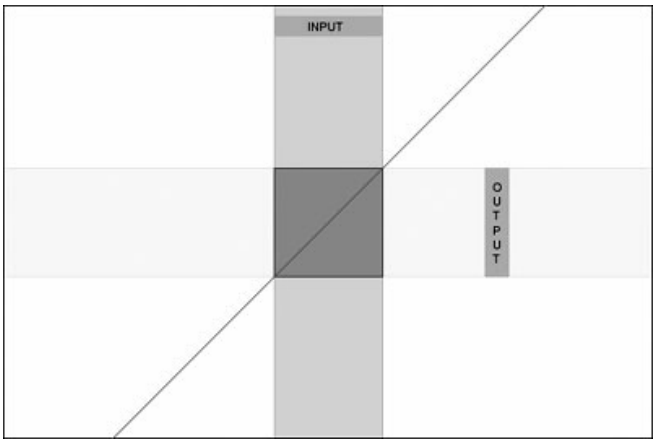
Reflect: With the Beyond Output set to Reflect, the portion of the curve which pokes out above the Max Output is reflected in not only the area within the input range, but also in all of the repeated copies.

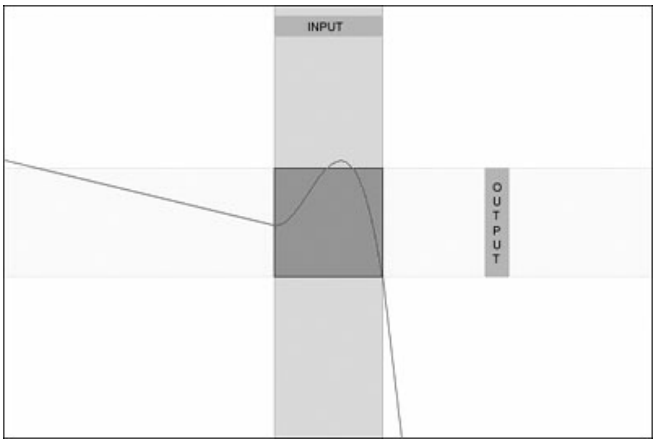


Beyond Input = Repeat
Beyond Output = Reflect

In this last table, the Beyond Input DDLB is set to ‘Bind Output’ and the Beyond Output DDLB is set as indicated. In earlier versions of MojoWorld, this option did not exist. It was very confusing for users to have output coming out of their curves which was outside of the specified output range when the Beyond Output was set to Clamp or Reflect. To ensure that the output from a curve is always limited to the specified output range, the Beyond Input option must not be set to ‘Continue’ as that option allows data outside of the input range to be remapped to any output!

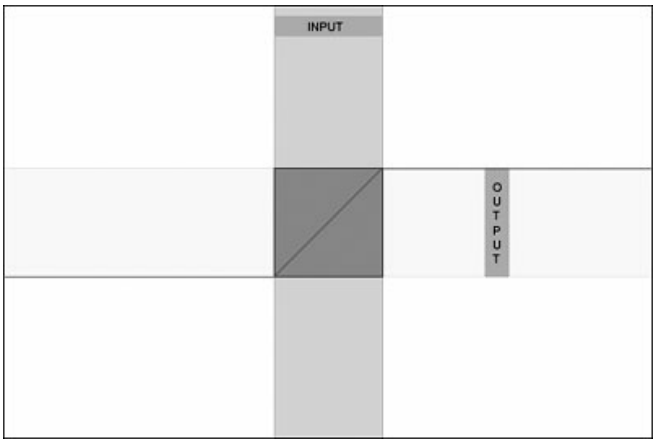
No Change: With the Beyond Output set to No Change the two examples are the same as the default examples. Because the output is specified as No Change there is no binding to take place.

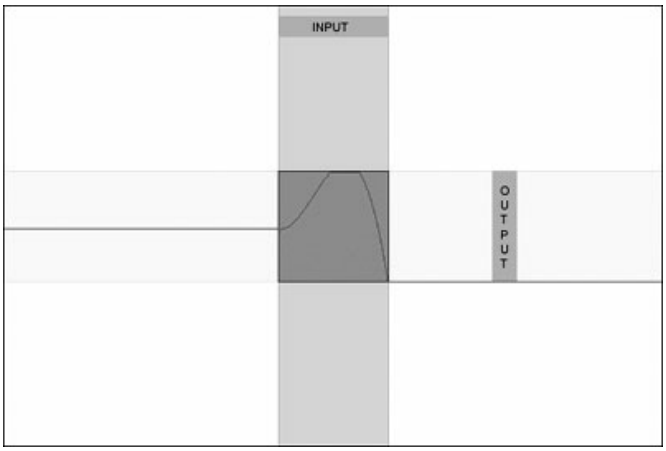




Beyond Input = Bind Output
Beyond Output = No Change

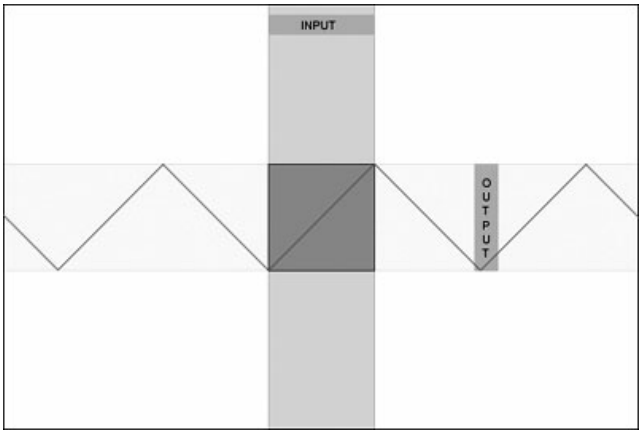
Clamp: With the Beyond Output set to Clamp the effect is the same as having both Beyond DDLBs set to Clamp.

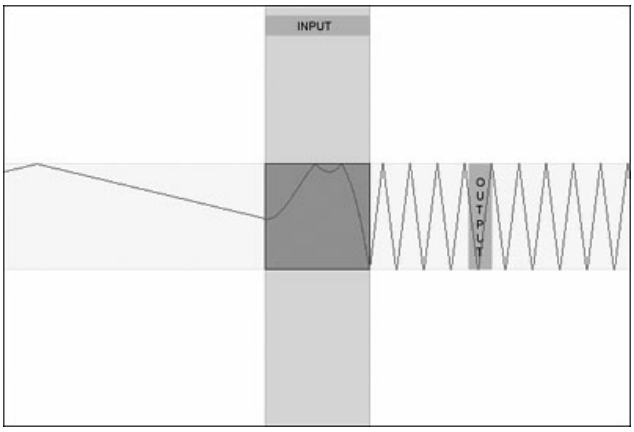




Beyond Input = Bind Output
Beyond Output = Clamp

Reflect: This last case is the one which demonstrates the reason why the Bind Output option is required. The section of the curve which pokes out above the Max Output within the input range is reflected as dictated by the setting of the Beyond Output option. For data outside of the input range, it also is reflected, but as a simple straight line bouncing back and forth between the Min Output and Max Output values.





Beyond Input = Bind Output
Beyond Output = Reflect

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This page exists within the Old ArtZone Wiki section of this site. Read the information presented on the linked page to better understand the significance of this fact.

Importing DAZ Studio Content Into Mojoworld 3.0

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Tools Needed

- DAZ Studio
- DAZ Gorilla LE
- Mojoworld 3.0 Pro/LE

Introduction

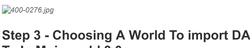
This tutorial is an introduction to importing content from DAZ Studio into Mojoworld 3.0. It focuses on selecting, setting up and exporting content with DAZ Studio. Then selecting a planet and a specific location on the planet in Mojoworld 3.0. Loading, resizing, repositioning imported content are then dealt with. Then adjustments of camera view, rendering and, finally, saving your imported model as part of a planet file itself.

Step 1 - Setup Content Ready For Exporting From DAZ Studio

Load Gorilla LE into DAZ Studio and set it up as you wish.

Step 2 - Exporting From DAZ Studio

Go to File > Export and save to OBJ file as if you were exporting to Bryce 5. Mojoworld will read the obj format OK. For ease of access later, I saved the Gorilla LE to my GorillaLE sub-folder which I'd setup in my DStudio2MJW folder.

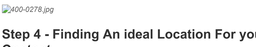


Step 3 - Choosing A World To import DAZ Studio Content To In Mojoworld 3.0.

At this point, you can close DAZ Studio. Then launch Mojoworld 3.0.

When Mojoworld initially launches you are presented with a default empty planet. From here you can create a planet from scratch, but for our purposes we will be using a pre-existing planet file. To access a pre-built planet, go to File > Open Using Browser.

This will launch the Library Importer - planets folder. Using the browser option the planets are visible as thumbnails. Left clicking once on a particular thumbnail of a planet will launch a larger view and description on the left side of the browser window. Double left-clicking or selecting OK in the top right of the browser window will launch your selected planet.



Step 4 - Finding An ideal Location For your DAZ Studio Content

With the selected planet now loaded, you will see a Real-time-render (RTR) which is less detailed that a photo-realistic (final) render. Standing still in one location can improve the viewing quality though. The RTR is mainly for exploration and is produced using your Video Card. The photo-realistic rendering is produced using your pcs CPU.

There is also the smaller Zip renderer in the upper left corner. This provides a much smaller but photorealistic preview. Right clicking in the zip renderer will also enhance the preview render.

To move around in Mojoworld there are many options. The two I'm highlighting in this tutorial are RandomCam and Jognav. Both of these can be accessed via the strip of tools along the bottom of the main view window, the RTR view

The randomCam is a a fast easy way to move between locations on the planet. Clicking on the 6 dice face will transport you rapidly to random locations on the planets surface. Clicking the 2 dice face will show random views in the same basic location. Clicking the + will add views to a stack of possible locations which can by accessed later.

Great for rapidly exploring a planet and getting an idea of the general terrain and views. Plus the store Cam views option mean you can continue to look for better locations even if you find somewhere that is sort of OK.

The second way to explore the planet surface is via the jogNav this is a directional control pad which when you right-click and hold down on a directional arrow in the jognav. This allows you to go forwards, backwards, left and right, according which arrow you've selected. Click > hold on the cross in the centre. In the top arrow position this you circle vertically forwards and round. The bottom arrow position and you circle vertically backwards and round. Click > hold on the left arrow position and you rotate horizontally sideways to the left, Click > hold on the right arrow position and you rotate to the right.

Theres also an altitude control to the right side of those other controls. Click > hold on up arrow and hey presto you ascend. Click > hold on the down arrow and you descend.

For quick altitude adjustments there also a 10 km autojump option and a 2m auto-jump option.

These controls allow you to navigate and select direction and height you want travel and view from.

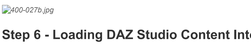
The arc above with two lines on is also control for adjusting camera angle so you can use that to zoom in and zoom out the view.

Using the Jognav you access locations by manually directing movement across the planets surface. Using the Randomcam you access random locations at the virtual roll of a dice.

Whichever method you choose when you've found an ideal location for importing your DAZ Studio content to, its now time to move on.

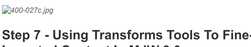
Step 5 - Importing DAZ Studio Content Into Your Chosen Location.

To import your model into Mojoworld 3.0. From the CREATE > primitives selection area on the left. Chooose the teapot. Not to make a cup of tea, but to import your obj file. Right Clicking on the teapot will highlight it in red and will also launch an import window. Obj is an automatically supported format, so simply find your import content and rightclick to select and then click Open. This will initiate the launch of your import into MJW 3.0.



Step 6 - Loading DAZ Studio Content Into the View.

You should see a set of cross-hairs and the words 'Drag in RTR to Place Object'appear in the main view window (RTR). Right click and hold down the mouse button, then move the mouse to introduce the mesh into the scene. Moving your mouse forwards will increase the size. Moving backwards will decrease the size. At this point its a good idea to make sure you load the Import large enough to be easily visible in your scene. You can resize and reposition later.



Step 7 - Using Transforms Tools To Fine-tune Your Imported Content In MJW 3.0.

With the model loaded, you will probably need to make some adjustments. You should see the new content with a purple bounding box around it. In the centre you should also see an X. Right clicking on the cross and holding you can quickly move your mesh around locally.

On the left is a group of tools called Transform. The first three:

the box

the circle with three arrowed lines

the dot with a three-quarter arrowed circle around it

These are the tools we'll focus on.

Right clicking the 'box' icon will activate the resize option. This is achieved by way of either grabbing a corner of the purple bounding box which should have lightbrown cube in it, or moving your mouse to one of the faces of the bounding box which should change to a yellowy colouring. Clicking on the corner and moving allows for resizing of the whole mesh. Using a face allows you'resize along the x, y or z co-ordinates.

Clicking on the 'circle with three arrowed lines' will active the movement option. and a three pointed gizmo should become visible (similar to DAZ Studio) Click/grab one of the pointy lines and you can move the imported content in the x, y or z direction. Basically forwards-backwards, side to side, up and down.

Clicking on the 'dot with three quarter circle around it' will provide access to rotational control again similar to in DAZ Studio (except only applied to the whole model not individual parts as in DS)

Step 8 - Adjusting Camera-angle Using A Second Option On The JogNav

When you have your content positioned where you want it you can make adjustments to your camera view using a second option on the JogNav. This only becomes active when a mojo-primitive, light or model is present. Clicking on the centre of the imported content here, so that the purple bounding box is visible, makes that your current selection and activates this new option.

Now a new camera icon appears in the jognav at the bottom of the Viewing screen. You can now change the function of the JogNav by clicking on this camera icon. This changes the way the jog nav operates so that it becomes centred on the selected object. Using the Jognav now, movement is around the object. This can produce excellent new perspectives and views and allows you to fine tune, even further, the final view that your render will show.

Step 9 - Simple Rendering

This is a simplified approach to rendering in Mojoworld 3.0 Pro or LE. There are other more advanced approaches, but this is the way you will initially find easiest and most obvious to use.

So, with your preferred planet loaded, location identified, DAZ content imported and viewpoint finalised. You can now render your image.

This is done at the top above the RTR view. The render itself is started by clicking on the camera icon there. The render setting is selected via clicking on the arrow and three lines next to the camera icon. This launches a stack of options with 5 render quality settings displayed in the centre. These range from low to maximum. Low through to normal are automatically rendered without shadows and therefore are faster. However, your imported content may look odd or out of place, without shadows to ground it into the scene. High and Maximum settings have shadows on. They take longer to render but provide higher render quality and your imported content will look more at home as the shadows help integrate there.

Rendering directly via the low to maximum settings selection will output an image 857×523 pixels in size. (The resolution settings can be altered but for ease in this introductory tutorial I decided to go with the pre-set default)

This will launch a new render window in MJW 3.0. When the render finishes theres an icon in the render window which has been described before as 'a pile of pancakes' ...lol.

When clicked, this will open a save render dialogue box. Here you can save your image in various formats: JPEG, PNG, BMP, etc. The general preference is to save as PNG and for posting to galleries online - convert to JPG after postworking.

Step 10 - Saving Your DAZ Content On A Mojoworld Planet File.

Finally, once you've gone to the effort of setting up content with DAZ Studio and loading it into Mojoworld. You might as well save the content within mojoworld itself, so you can easily re-use it later. To do this click File > save As and then in the new Library Exporter - Planet window choose your own name for your saved planet. You also get to save the last rendered image or do a new image. so you have a viewable thumbnail which will make accessing that particular planet easier with the browser used in step 3. You can also save a description too. So can add notes for yourself to remind yourself of the planets content when you view it again later.

Theres lots of other details for importing and using content. However my intention here was to provide you with a basic sequence from selection/setup of content in DAZ Studio to final render and then saving content on a planet in Mojoworld 3 Pro/SE.

I hope this has provided you with a primer to get you started using DAZ Studio and Mojoworld 3 together.

Happy modeling and rendering!

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